POPULAR MECHANICS

"Written So You Can Understand It."
"Tells You How to Do Things."

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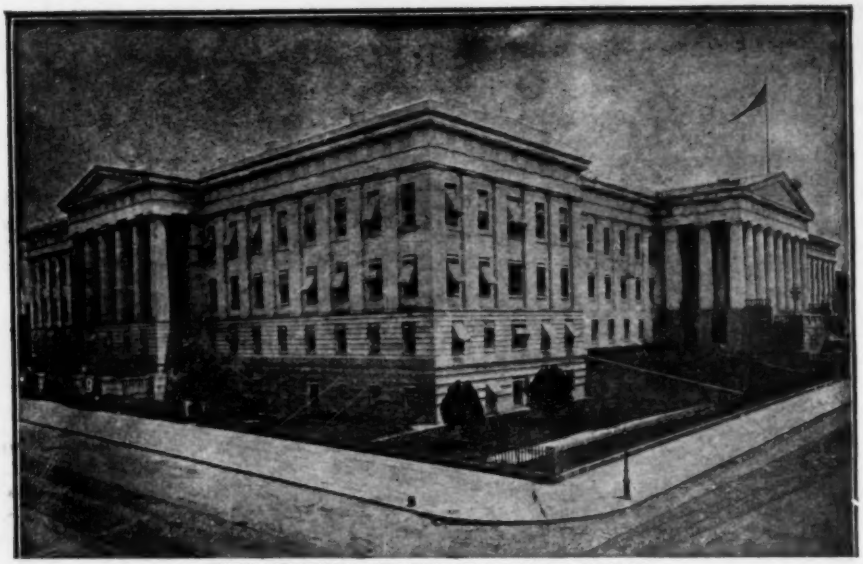

THE UNITED STATES PATENT OFFICE

Through its Patent Office the United States Government grants about 25,000 patents a year—more than are issued by all the governments of Europe combined. The records of the Patent Office show that about 18,000 patents are sold in whole or in part every year. It is conceded that the pre-eminent position of the United States in the industrial arts, in science and agriculture, is due to American inventive ability more than to any other single factor. And not only do we profit as a nation through the efforts of our inventors, but we furnish examples and ideas to the profit of all other nations.

In an experience of 25 years' practice before the United States Patent Office and the Courts and with mechanical devices of every description, we have learned how:—

1. To complete and perfect inventions of all kinds.
2. To save the cost of expensive models and drawings of new inventions.
3. To find out if an invention is new, and if so, whether it is sufficiently novel and useful to to justify the expense of a patent on it.
4. To prepare drawings and specifications that faithfully and accurately embody the inventor's ideas and claims, that fully protect the novel principles involved in his invention.
5. To obtain patents that will save the patentee from being sued as an infringer, and also protect him from loss through the infringement of his patent by others.
6. To procure strong patents that cannot be evaded by imitators or patent pirates. To obtain patents that have been refused at the hands of incompetent attorneys.
7. To get at the cost of making and selling new inventions.
8. To profitably place inventions on the market, and to find buyers for good patents in the United States and in foreign countries.
9. To draw contracts between inventors and their financial backers. and between employers and employees, so that all parties will be protected.
10. To incorporate companies for manufacturing new inventions.

We do not claim to know it all, but believe that we are well equipped to render reliable and competent service as patent experts and attorneys. We do not offer our services free of charge, nor on the other hand, do we ask exorbitant fees. Every case has our personal attention from beginning to end. Our charges are those usually made by reputable patent law firms for similar work, and where possible, are always made known to our clients before the work is undertaken.

Our Mr. Moore has been a practicing lawyer before the Courts of Illinois and the United States for eighteen years, and has had extensive experience in designing and perfecting intricate inventions, many of which he has sold at considerable profit. Our Mr. Benjamin for more than twenty years was engaged in Washington, D. C., as a Patent Attorney. has successfully prosecuted hundreds of applications for patents before the United States Patent Office, and has as principal or associate counsel been connected with some of the important patent and trademark litigation of the country.

We have associates in Washington, D. C., and in London, Berlin, Paris and Copenhagen, by whom all business requiring personal attention at these points is given prompt attention.

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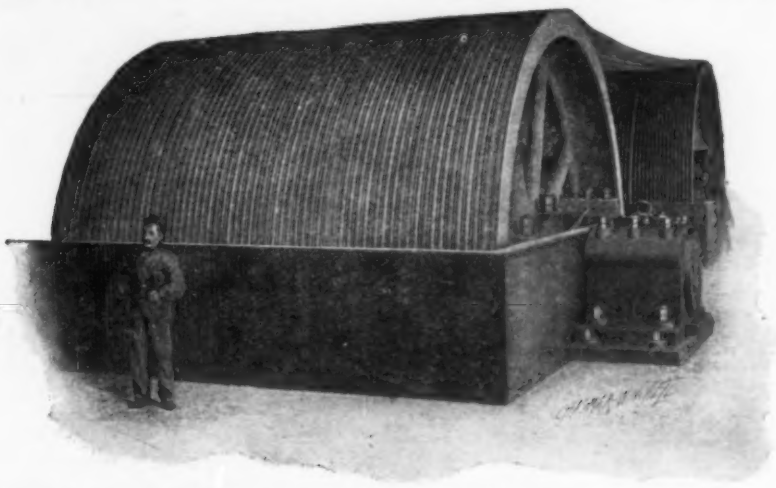


3,200 H. P. Drive, Composed of Sixty 2-inch Transmission Ropes, at Sharon Steel Company's Plant

Manila Rope is Supplanting Belting

Acquisition of Philippine Islands with Their Famous Fiber Marking a New Era in American Industry

Acquisition of the Philippine Islands and the consequent increased traffic in Manila rope have brought that commodity into a commercial prominence few ever dreamed it would attain. It is causing Manila rope to supplant belting as a means of power transmission in many of the new mills and factories throughout America and the manufacture of transmission ropes has suddenly sprung into such importance as to be classed among the greatest industries of the country.

From no country in the world except the Philippine Islands can the fiber be obtained for the successful manufacture of these rope drives. It is made from the abaca plant, growing only in the Philippines, and since America's occupation forming the islands' leading agricultural pursuit. The trunk of this plant resembles the banana tree. It is closely enfolded by long leaves, from which is produced the fiber of such wonderful strength. From this fiber, or Manila hemp, matting, canvas, ropes, paper and cables of the finest quality are made. All the world is familiar with the merits of the Manila paper made from the abaca hemp.

But most of all is the fiber suited to the requirements of rope. The fiber usually varies in length from 6 to 12 feet, but in some leaves attains a length of 18 feet. Its tensile strength surpasses that of any other fiber known to man. Official tests at Watertown, Mass., have proved its strength to be in excess of 50,000 pounds per square inch.

Of course there are other materials used in manufacturing ropes for transmission purposes, but none of such general utility as the Manila fiber that comes from the far-off Philippines. The other materials

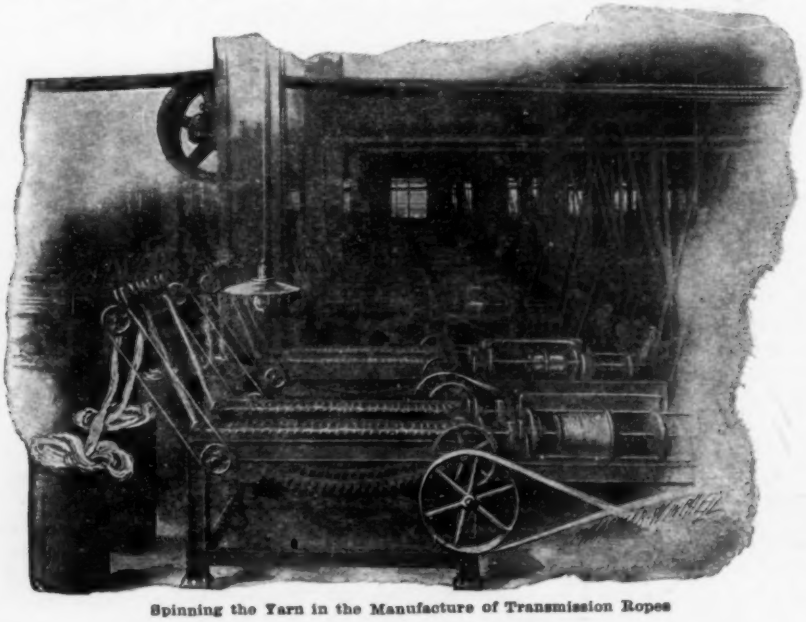
are steel or iron wire and cotton. Wire rope is well adapted for the transmission of large powers to great distances, as, for instance, in cable and inclined railways. Its rigidness, great weight and rapid destruction, due to bending, however, unfit it for use in mill service, where the average speed of ropes is about 4,000 feet per minute. As the easiest way to break wire is by bending it, ropes made of it, by any method whatsoever, have proved unsatisfactory for drives of short centers and high velocity.

Cotton ropes are advantageously used as bands or cords on the smaller machine appliances; the fiber, being softer and more flexible than Manila hemp, gives better results for small sheaves; but for large drives, where power transmitted is in considerable amounts, cotton rope, as compared with Manila, is hardly to be considered. It is far less durable; it is injuriously affected by the weather, so that for exposed drives, paper mill work, or use in water wheel pits, it is almost worthless; it is difficult, if not impossible, to splice uniformly; even the best quality of cotton rope is greatly inferior to the poorest Manila in strength, while for the transmission of equal powers the cost of cotton rope varies from one-third to one-half more than the best Manila. Manila fiber is causing America to become famous for making the finest transmission

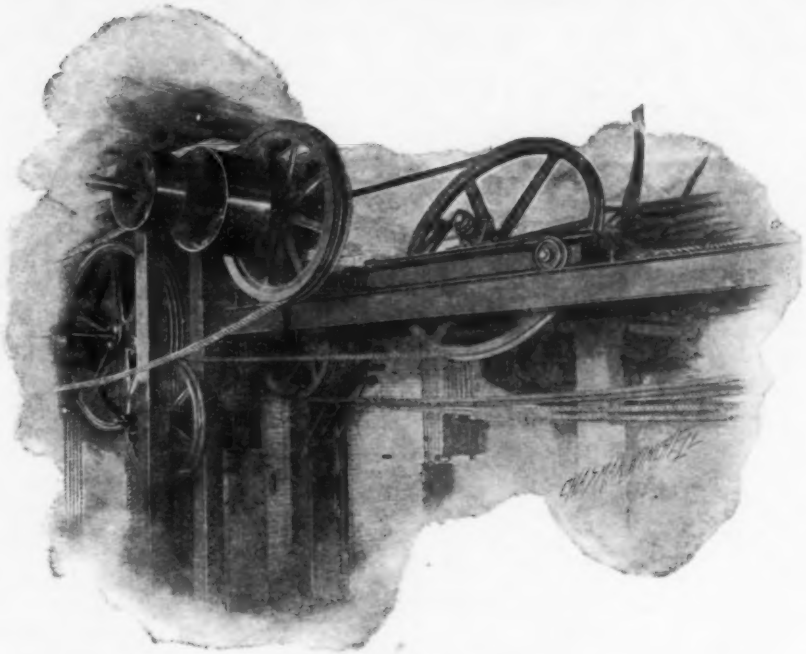
2-inch Diameter Rope, 2,500 Feet Long Without a Splice

ropes in the world. The fiber is brought here in shiploads from Manila and after being made into rope at American manufactories is shipped to England, France, South Africa, Australia, Japan and other countries. England was in advance of America in successfully using rope driving, but since our superior access to Manila hemp we now send rope drives to England.

Frederick Stewart Greene, one of the American Association of Civil Engineers, who in the interest of the American Manufacturing Company recently completed an 18 months' tour of the continent, visiting every house employing rope drives in the



Spinning the Yarn in the Manufacture of Transmission Ropes



Tension Carriage and Track.

United States and Canada, says:

"Satisfactory driving may be done when the distance between shafts is as great as 175 feet, without the aid of carrying pulleys. The amount of power which may be transmitted is practically unlimited. There are several drives in this country which are transmitting from 3,000 to 4,000 horse power with perfect satisfaction, a good example being the rod mill drive of the Sharon Steel Company. (See illustration.)

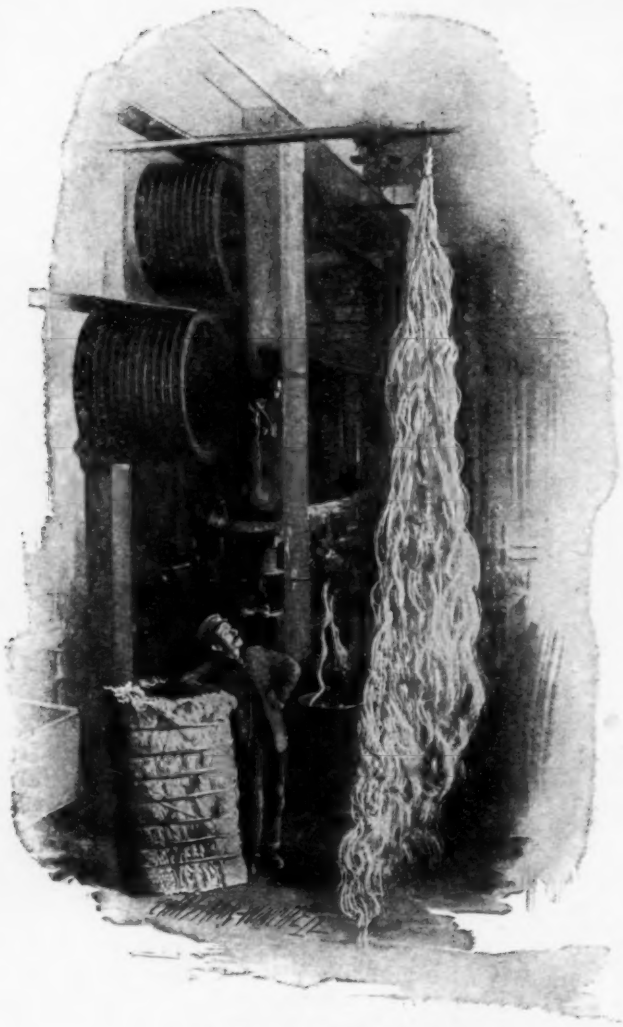
"In drives of 200 horse power and where the shafts are more than 30 feet center to center, the cost as compared with belts will vary from 15 to 50 per cent in favor of ropes, according to the distance and size of drive. This advantage increases as the distance apart in shafts and amount of power transmission increases.

"The average life of rope on a properly designed drive is from eight to ten years, and during this time the only care it requires is correct splicing and a "run" free from obstructions, for a properly constructed transmission rope needs no external dressing whatsoever. The width of rim surface required in rope drives is only from one-half to two-thirds that required for belting, varying with the size of rope used. It follows, therefore, that the supporting bearings may be placed nearer together for a rope than for a belt drive. The elasticity of the rope, its light weight and slackness between pulleys take up inequalities in power and load, thereby producing more positive and regular running than exists in any other system of power transmission.

"Rope drives are noiseless—a fact due to the flexibility and lubrication of the rope, and to the air passage in the groove, between it and the sheaves. This holds good for large as well as small drives, and where the bearings are properly cared for absolute silence is secured, though horse power in thousands is being transmitted and the ropes are traveling a mile a minute.

"In properly designed rope drives, where diameters of the pulleys are sufficiently large and angle of groove correctly turned, loss of power by slipping becomes so infinitesimal that no allowance should be made when calculating speed for driven shaft."

There are two distinct systems of rope driving—the multiple, or English system, and the continuous, or American system. Each has its partisans, and under different conditions each has its advantages.



Bale and Hank of Manila Fiber

The multiple system is the simpler, consisting of one or more independent ropes running side by side in the grooves of the pulleys. In the continuous system one is wound around the driving and driven pulleys several times. With this system it is necessary, by some device, to conduct the rope from an outside groove of the delivering to the opposite outside groove of the receiving pulley, this transfer being accomplished by means of a traveling tension carriage, in England styled a "jockey," whose office it is to produce a uniform tension throughout the rope. It is so arranged as to travel back and forth automatically, regulating the slack which may occur from stretch in the rope, inequalities of load, etc.

Well-proportioned rope sheaves, properly turned grooves and a good transmission rope form a combination which has been truly styled "the prettiest piece of work in mechanics."

So successful has been the experiments with oil fuel on the Santa Fe road that large additional tracts of oil lands are being purchased for the purpose of extending the service.

VINEGAR RELIEVES BURNS FROM FIRE OR ACID.

Vinegar or acetic acid is a sure, swift and easily procured remedy for either internal or external burns, as well as a positive antidote for carbolic acid poisoning. It has been demonstrated before the medical profession that vinegar, the most common household necessity, if applied immediately will bring relief and complete restoration of color and function to the affected parts.

In the case of burns either from fire or acid the parts must be bathed freely with the vinegar until relief is obtained, which will be felt in a very few minutes. In carbolic acid poisoning vinegar, diluted with an equal amount of water is administered internally in doses of about a half an ordinary cup, relieving the burning almost immediately and assuring safety until the arrival of a physician. This simple remedy has been tried in numberless cases and found to be thoroughly efficient.

An Ohio hardware man advertised heating stoves last winter by setting one out on the sidewalk and building a fire in it on very cold days.

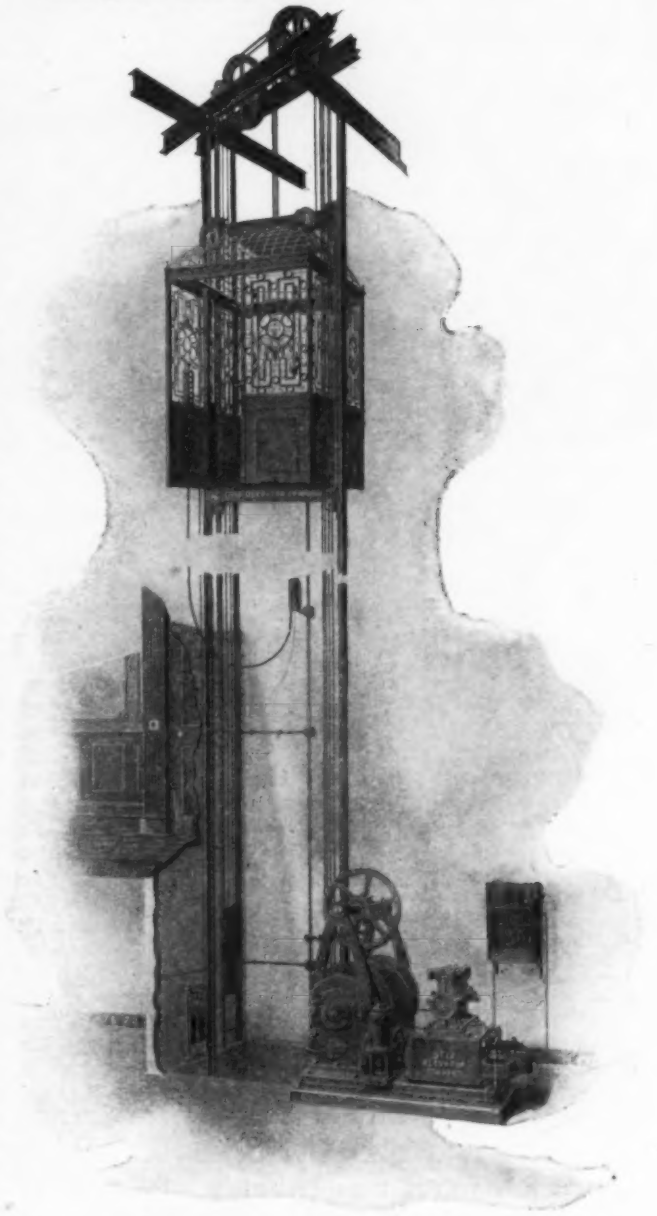
Good-Bye to the Elevator Boy

New Lift Appears with Mechanical Appliances, Making His Job Useless

The elevator boy is doomed. The "boyless" elevator has made its appearance. At first designed only for residences, this electrical lift has met with such widespread favor that it is destined to supersede the old style elevators in all modern flat buildings, hotels and many office buildings. In this car the passenger is "his own elevator boy." If he is on the fifth floor he presses the button and the elevator appears and stops at that floor. The door opens automatically and he steps in. If he desires to go to the eighth floor he presses button No. 8 inside the elevator and the car ascends, stopping at the desired floor without further effort on the part of the passenger. If he desires to go down to the first floor, he presses button No. 1 inside the elevator and the car descends until it reaches that floor, stopping en route to let on passengers who have pressed buttons at intervening floors.

This new type elevator is manufactured by the Otis Elevator Company and is known as the Otis electric elevator.

The car will not leave the floor unless the door is tightly closed. The push buttons inside the car correspond in number to the numbers of the various floors. Should the passenger desire for any reason to stop the car at any point of its travel, he can do so instantaneously by merely pushing the safety button with which the car is provided.



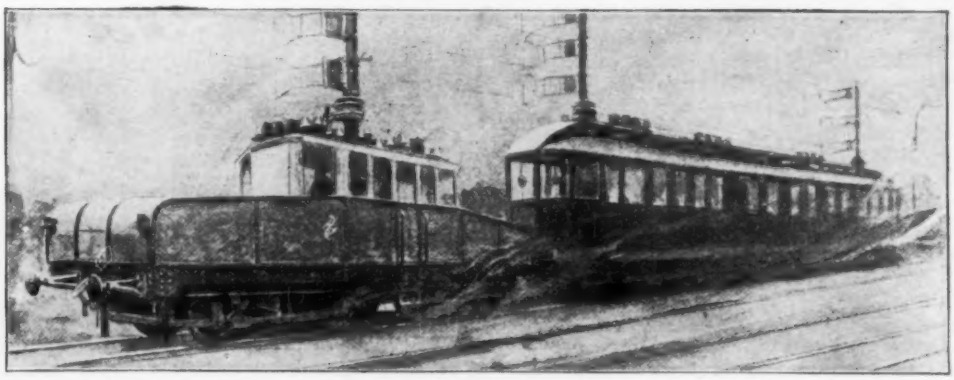
Showing Mechanism of the "Boyless" Elevator

Just now the "boyless" elevator is confined to buildings where there is not an unusual amount of traffic, but with new improvements that are being added, it is only a question of a short time when it will be so perfected as to almost, if not entirely, supplant the present style of lift. At present it is most popular in hospitals, but it is rapidly invading new fields, and has already appeared in several modern office buildings

Germany Has Amazed the World

Electric Car Makes Fastest Speed Ever Attained on Rails--Description by a Scientist Who Made the Trip

By Guillaume d'Aignilion, the noted French scientist, who rode on the electric car in Germany while it traveled 130 miles an hour.



Motor and Carriage Speeding 130 Miles an Hour

The recent record of 130 miles an hour, made by the Marienfelde-Zossen electric line is one of the most remarkable feats in history and is the speed sensation of the century.

But an even greater speed is to be attempted on this line. One hundred and forty miles an hour is believed possible by the engineers who conducted the test.

"In fact," said Herr Halske, one of the engineers present, "if it has been possible to make 130 miles an hour, why is it not possible to make 230 miles an hour?

Certainly! Why not 330 miles an hour, or 430 or why have we any limit at all?

For weeks large forces of men had been busy putting the tr:·k which is laid with standard 100-pound tee rails in the most perfect condition. Every joint was perfect, every rail in the most absolute alignment, and the result was unquestionably the best piece of railroad track ever built. We quickly attained a high speed, the car riding with a gliding motion, more current was turned on and the speed almost instantly increased. We seemed now to be sailing through the air like a bird; the motorman moved the controller over several notches. Now the trees seemed to dart by us as if they were being hurled through space by some powerful force. Faster still we moved; objects began to lose their shape; hills seem like great cannon balls being shot by us; the speed becomes terrific and the sensation is most exciting; nothing can now be distinguished; no trees, no posts, no rocks, no hills, no fields, no ground, no anything—just stripes of indistinguishable masses that sweep by us like ribbons unfurled to the gale. Faster still we go and even the stripes cease and all outward objects form themselves into a blur. Where are we going? On what are we traveling? Are we on rails or in the air? We could not answer. We could not see, we could not tell anything; we could only stand there as if transfixed while being hurled through space as if shot from a cannon. Each second we had traveled 191 feet. The sensation thrilled our nerves. Our brains seemed to reel with the strange sensation. The experience was worth traveling around the world to experience.

Fourteen passengers were on board the car at the time the experiment was made. The lives of all were heavily insured, but the trip was made without the slightest accident. The car machinery and roadbed stood the test well, though the engineers admit that under existing conditions a speed on regular trips of 130 miles an hour is as yet more possible than practicable.

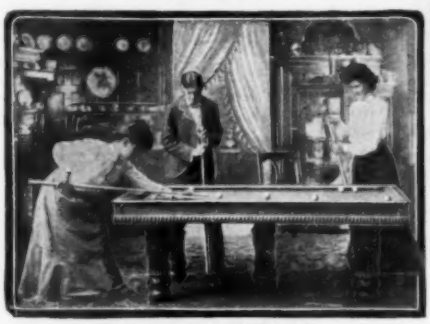
The current was between 13,000 and 14,000 volts transformed down to 600 capable of driving the car at the rate of over 200 miles an hour. The car had four motors, exerting about 1,100 horse-power. A curious phenomenon accompanying the test was the continuous sparking from the six trolley arms.

Wonderful Combination Table Has Appeared

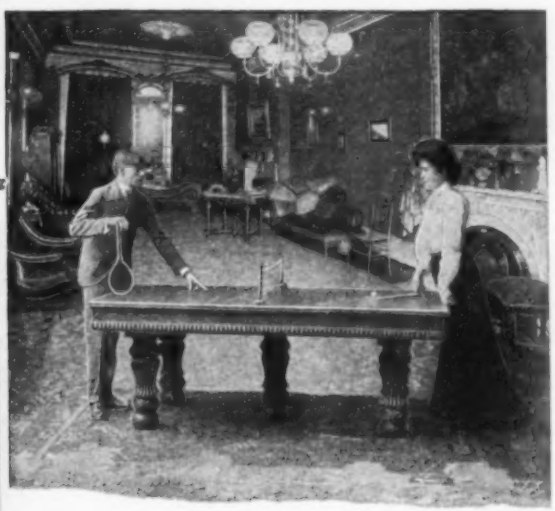
Used for Dining, Billiards, Pool, Ping Pong and Reading--Keeps Husbands at Home in "The City of Clubs"

To keep husbands at home an ingenius contrivance has made its apearance in Indianapolis, a city said to have more men's clubs than any other municipality in America in proportion to it size. The device is a dining table, a billiard table, pool table, ping pong table, card table and library table all in one. In fact on this one piece of furniture may be afforded nearly every amusement that so entices the man in the club. Besides it gives a wonderful amount of amusement to the women of the house, and since this combination board has arrived the society women of Indianapolis are becoming wonderfully expert with the billiard cue.

Combination Dining, Billiard, Pool, Library and Ping Pong Table



It Amuses the Women



As a Ping Pong Table.

The table offers a multitude of advantages. When the family has religious visitors the oak top is allowed to remain over the billiard cushion and there is no indication that there is anything more present than a very reverend piece of oaken

furniture. When the devout people have gone and visitors of more liberal tastes appear the top is gently lifted, and, lo, there is revealed a full-fledged billiard or pool table. An innocent-looking case in the wall is thrown open and there are the cues and billiard balls, and soon the merry game is on. Then by removing the top sides the device becomes a ping pong table. But insignificant changes are necessary to convert it into the other articles of furniture mentioned.

Indianapolis Expert Women Billiard Players in a Contest.

Good-Bye to the Watt Engine--Welcome the Turbine

The Mechanical Review of London says: "The steam engine designer, whose knowledge and experience were acquired at the close of the 19th century, has perhaps already begun to apprehend that much of his learning and skill is becoming useless in his profession. Stores of carefully gathered memoranda with regard to steam cylinders, cut-off valves, jacketing, as well as proportions of piston-rods, connecting-rods, cranks and crank-shafts may already be looked on as fossilized relics of an industry that has perished. He sees that a new order of things has arisen, and a new set of problems will have to be encountered, if he is to continue in the calling of a mechanical engineer.

"A well proportioned reciprocating steam engine of the multiple-expansion type is still a beautiful work of art; but aesthetical conceptions must give way to utiltarianism. We have to bow to the remorseless decrees of progressive science. The palmy days of the Watt engines are gone, never to return. Builders of the best of these structures may at once accept the inevitable. No longer can they found their hopes upon superheating, higher pressures, or more extended expansion. All that is possible in these directions can be turned to account more advantageously in the new motor, the steam turbine.

"The five years' extension of the Hon. C. A. Parson's patent expired a few months ago, and there is nothing now to prevent steam engineers from turning their attention to the manufacture of turbines. The change may be repugnant to many; it is revolutionary. It involves the study of conditions with which they are unfamiliar; and it may be that only by a system of trial and error will they arrive at a really good marketable product. But the adventure must be made, for with all its defects the turbine is already a superior power-transmitting machine. Free from many faults of the piston engine, it yet lacks some meritorious features, otherwise there would be no room for comparison."

Harnessing the Power of Mountain Streams

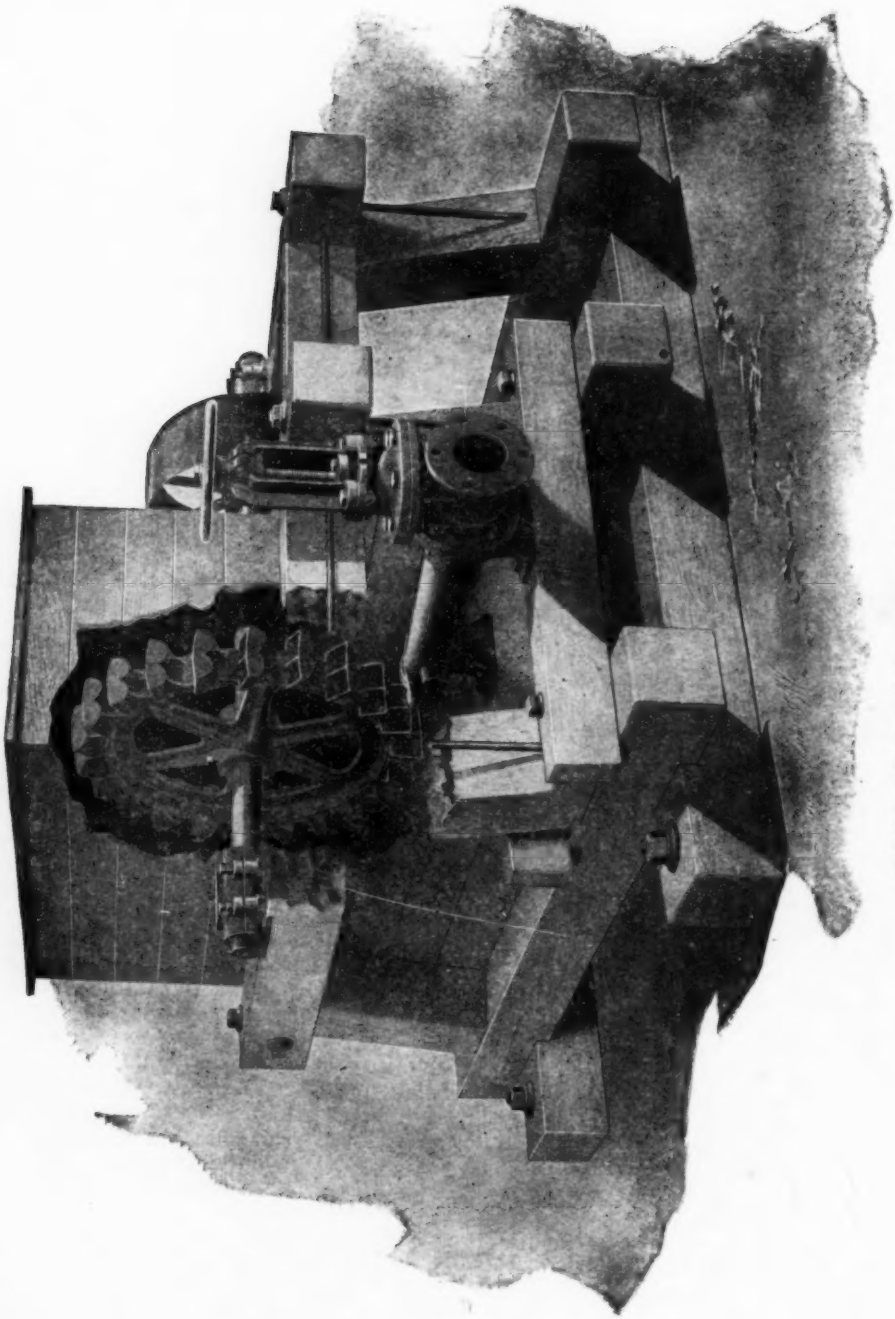
Modern Water Wheels and Electric Transmission are Working an Industrial Revolution

Force generated by the flow of water in mountain streams of the United States is sufficient, if developed, to run the combined machinery of all the factories of the country, with an abundance to spare. There seems to be a general awakening in all parts of the world to the possibilities of the enormous energy going to waste in swift-flowing waters. In the Alps and in the mountains everywhere nature furnished to man a power in the water that descends from the mountain springs, in comparison to which that given by the coal consumption is insignificant. The world's water power has been estimated to amount to 10,340,000,000 horse power in perpetuity. The yearly coal output of 225,000,000 tons would give that horse power but little more than half a day.

Through the agency of electricity part of this force is now being turned to a more general use. It is electric power transmission, that may convey the power to points 200 miles distant, which is causing the awakening to the economy and other advantages of water power. The old methods of utilizing water power were clumsy and offered but small inducements. It is no wonder that the millions of horse power were allowed to flow uselessly down the mountains' sides before electric power transmission was understood. But now a change has come over the spirit of things and we may look for a great comparative decrease in coal consumption and an increase in the building of great manufacturing centers within electrical transmission distance of swift-flowing streams.

The wonderful advantage of the electrical method of transmitting power over the old mechanical method may be comprehended from this comparison from L. B. Stilwell: A steel cable, 1½ inches in diameter, traveling at the rate of 12 miles per hour, can transmit nearly 2,000 horse power; but by taking a copper wire 1 square inch in section, and applying it to a potential of say 10,000 volts at 1,000 amperes per square inch, we find we are transmitting in an invisible form over that wire more than 13,000 horse power, which is enough to rupture instantly six such cables as are ordinarily used in operating a cable railway. As much power can be transmitted through such a copper wire, under the conditions named, as through six belts six feet wide and running at the rate of a mile a minute.

The old-style water wheels were picturesque, as the illustrations will show, and they served their purpose right well in their day, but later methods drove them prac-



Standard Pelton Wheel Mounted on Wood Frame.

tically out of business and many of them yet stand idle, merely monuments of a past civilization. The old-style wheels were known as the overshot or gravity wheels. The modern wheel is the undershot—moved by the water passing beneath—what is known as the Pelton wheel being most generally employed in America. This wheel has caused electric power transmission plants to spring up in many parts of the United States, Mexico, Central and South America and Canada, and has demonstrated to the world the practicability and economy of employing water power for generating electricity for nearly all purposes where power is required. Power from Niagara Falls has been harnessed to operate all the street railways and numerous manufacturing plants at Buffalo. In the Rocky mountains many plants have been built and owners are growing rich in utilizing the great natural force the mountains provide. Mining plants and factories of every description are operated electrically from the water power. The Pike's Peak Power Company, located near Victor, Col., is one of the most important in the country. The Edison Electric Company's stations of Southern California transmit power 80 miles from Crafton to Los Angeles, Cal. The Telluride Transmission plant supplies power to numerous Colorado mines. The Northern California Power Company supplies power for a multitude of uses, and all over the mountain districts of America water power plants are making their appearance in large numbers.

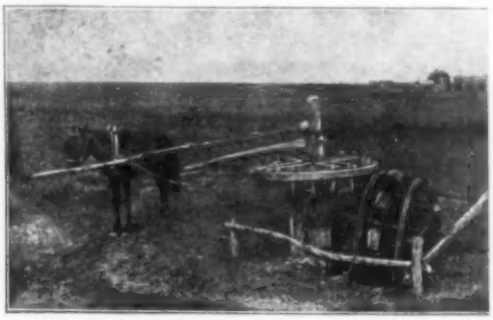
Stone & Webster, the leading electrical engineers in electric railway construction, have recently completed one of the finest transmission plants in the world. The melting glaciers of the Coast Range furnish water power for the generation of electricity which operates all the street car lines on Puget Sound.

A. P. Brayton, president of the Pelton Water Wheel Company, says: "A great industrial revolution is taking place in the development and various uses of electric power, the full significance and far-reaching effect of which are only now becoming understood and appreciated.

"Electrical energy in its present stage of development is recognized as the most potent of all forces, of universal application and a most important factor in industrial progress. Success in the past has followed so closely upon prediction that nothing in this way now projected along well-established lines is considered in any sense an experiment.

"Less than fifteen years ago it was impossible to transmit electric power commercially more than a few hundred feet; now transmissions of from 80 to 100 miles are quite within the limit of ordinary practice, and stations involving transmissions of over 200 miles are at this time in successful commercial operation. The progress already made in this direction indicates that the only limitations as to distance of transmission are those imposed by the outlay required for the conductor and the generating plant, and such other favorable conditions as are necessary to make a paying investment.

"The greatest progress in the transmission of electrical energy has, however, been in connection with the utilization of water power. With this as a motive force under all ordinary conditions electricity is conceded to be the most flexible, reliable and



Ancient System of Pumping Water in the West.

economical power known. With the interest now attaching to this subject, the means of making these vast resources available for power purposes in the most simple and efficient way has come to be of supreme importance, enlisting as it has the highest constructive ability and engineering skill known to modern science."

The modern Pelton wheel is carried usually on a horizontal shaft, supported by journal boxes, but in special cases the shaft may be vertical with step and thrust bearing. The water, being led to the wheel by means of a pipe, impinges on the buckets through a nozzle, the end of which is fitted with a cylindrical tip of diameter proportioned to the head of water and amount of power to be developed. Different diameters of tips can be screwed into the nozzle, thereby varying the power of the wheel from the maximum, which is limited by the

size of the bucket, down to a small proportion of the rated capacity. In this way no more water is used than is actually required for the power, and a uniformly high efficiency is maintained at all stages of the load. The power of the wheel does not depend on its diameter, but on the head and the amount of water applied to it—in other words, the size of the nozzle used, which establishes the size of the bucket on the wheel.

ROUMANIAN NAVAL DOCKYARD FOR SALE.

"Le Yacht" of Paris says: "The naval dockyard of the Roumanian government is on the market. Seven years ago this yard was taken over by the government from the Danubian Steam Navigation Company and was considerably enlarged by the government. However, something appears to be wrong somewhere, considering that the staff, which at the time of purchase numbered 1,200, has gradually been reduced to its present figure of 100 men. The government is now anxious to find a likely buyer, and Roumanian capitalists being out of the question, has had to look abroad for likely parties, but so far without success, owing it is stated, to the exorbitant price demanded. Only one serious offer has been made, and that by the former owners, who are willing to retake the yard at the figure sold by them seven years ago. The government, however, stands out for a higher figure, in consideration of the additions made since then.

A subscriber who was in arrears to a rural paper was dying and the editor dropped in to see him.

"How do you feel?" asked the pencil pusher.

"All looks bright before me," gasped the subscriber.

"I thought so," said the editor. "You'll see the blaze in about ten minutes."

INTERNATIONAL WIRELESS TELEGRAPH REGULATIONS.

The "Cologne Gazette" says: At the international congress of wireless telegraphy held in Berlin it was resolved that coast stations should be obliged to receive and forward all telegrams from vessels at sea by whatever system they might be dispatched. In order to facilitate communication between vessels and coast stations, technical explanations referring to the working of the apparatus are to be published.

Telegrams referring to wrecks, and attempts to render assistance to vessels at sea, are to be forwarded before all others. The rates for telegrams forwarded into the interior from a coast station will be those of the ordinary telegraph service plus a special charge for the use of the wireless apparatus, and will be paid for on receipt. Telegrams sent to a vessel will be paid for on board the vessel at the rates usually charged by the nation under whose flag the vessel sails. Stations are to be arranged so as to interfere with one another as little as possible, and arrangements will be made to insure correspondence in a number of technical details.

Provision is made for other states besides those which sent representatives to the preliminary conference to be parties to any arrangements which may finally be made for the regulation of wireless telegraphy. The most important of these resolutions is the one referring to the duty of coast stations to receive all messages without distinction of systems. This resolution was incorporated in a protocol which was signed by the representatives of Germany, Austria-Hungary, Russia, France, Spain and the United States. The representatives of England and Italy did not sign.

HOW TO KILL MOLES.

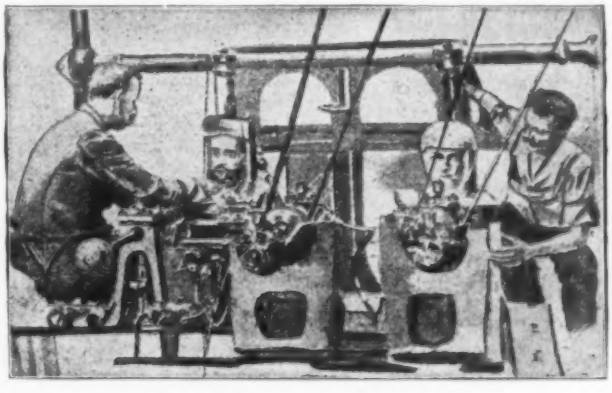
A writer in the Indiana Farmer tells how he kills moles. Buy five cents worth of strychnine crystals. With a pen knive raise the kernels of some grains of corn, and slip a bit of the strychnine under each kernel, pressing the kernel back in place. Then with a sharpened stick make a hole into the mole's tunnel, and drop one of the poisoned grains into it, covering the hole after the grain is deposited. "That's all."

New Machine Foretells the Sculptor's Doom

The Expert's Task of Months is Now the Amateur's Work of a Day

Simpler than retracing a drawing with the pantograph; easier than molding bullets from molten lead, and as accurate as the most skilled sculptor's work is sculpturing made by means of a new invention that has come from Naples. Now anybody may become a sculptor in a day, and in a day he can do more and better work than could the most capable of the old-time sculptors in three months. Years of study and practice under the old method are without avail since the electrical sculpturing machine has arrived.

Auguste Bontempi, of Naples, is the genius who has devised the mechanical sculptor that has done away with the art of sculpturing. W. G. Jones, an English sculptor, and A. Conan Doyle have purchased the English rights to the machine, which, when exhibited in London recently, created a sensation in the world of art.



Electric Sculpturing Machine

Sculpturing with the electrical machine is done practically on the same principle as a drawing is retraced with the pantograph. All the sculptor has to do is to guide a rod over his model and the machine carves from the marble in exact accordance with the rod's motions a perfect image of the model. Its operation somewhat resembles the sculptor's pointing machine.

The Monumental News says: "A rod which protrudes from the instrument is guided over the sculptor's model. A revolving steel drill protrudes a few feet away, and does the work of carving on the block of marble mounted in front of it. A jet of water plays on the point of the drill and keeps the surface of the marble free of the material that is ground off. A number of these drills can be mounted side by side, so that several replicas of the model can be produced simultaneously. The drills are moved in unison with the one moving over the model, and there is consequently no possibility of cutting too deep.

"The machine's greatest promise for usefulness seems to be in replacing the pointing machine and in the carving of architectural decorations, such as capitals, friezes and other decorative work so often required in Gothic architecture. A completed machine when placed on the market is expected to cost about $2,000."

MYSTERIOUS FIRE ALARMS AT LOWELL.

For a long time the fire department of Lowell, Mass., have been mystified by the constant turning in of false alarms of fire. The alarms were usually turned in between 7 and 9 o'clock in the evening. One night it would be in one part of the city; the next from a point far removed. After watching for several months the detectives discovered the cause. Quite a large number of men had formed a pool, into which each paid a certain sum. Each one had a guess on what box would send in the next alarm of fire, the correct guesser to receive the money. After selecting their numbers there was a scramble to see who could succeed in first getting an alarm in from his box.

America is to Cultivate the Bamboo

Wonderful Plant that is the Life of Japan--The Greatest Grass that Grows--There is No Bamboo Tree

Wealth, beauty of landscape, new styles of decoration and a new staple food may be added to America's resources through the introduction of the bamboo, a project that has already been successfully undertaken by the United States government. It has been found that many states of America have soil that is admirably adapted to the cultivation of the bamboo, and through the government's efforts it will probably not be long until great bamboo forests with their unparalleled beauty will be majestically waving in America and bringing fortunes to their owners.

Japan is the home of the bamboo. There the people build their homes of it; they serve it daily on their tables as food; they make from it articles of wearing apparel; it serves in the manufacture of agricultural and farm implements; it is made into ropes, cords, screens and troughs; the housewife uses bamboo kitchen utensils, mats, trays, baskets, sieves, window shades, picture frames and a hundred and one other ornamentations made from it; the leaves serve as napkins and wrapping paper. Japanese are warmed by bamboo fires in winter and cooled by bamboo fans in summer; they fish with a line made from bamboo fiber attached to a bamboo fishing pole, while they are protected from the sun by the bamboo forests; at noon the fishing party take their lunch from a bamboo basket and eat heartily from bamboo plates of their favored dish "Moso," made from dainty bamboo shoots. In fact, the Japanese and the bamboo are so closely associated that they are inseparable; one could not live without the other. Certainly, without the bamboo there would be no Japan.

The man that wrote the song, "Under the Bamboo Tree," was as ignorant of the bamboo as he was of song writing. There is no bamboo tree. Bamboo is a grass, the king of grasses, the tallest, biggest grass that grows. It sometimes towers to a height of 100 feet and may be of diameter equal to a pine tree. So far from being a tree, the bamboo cannot exist where trees are grown. Forest trees standing near a bamboo grove will prevent the growth of the bamboo.

The expression, "Yon can fairly see it grow," comes nearer being realized in the bamboo than in any other vegetable or thing that lives. Men who have kept close watch declare they have actually seen the bamboo shoots move upward in their phenomenal growth. Bamboos have often grown at the rate of three feet a day in height and one foot a day is quite common. The young bamboo stem is so tender that it can be snapped off by merely shaking it; the old matured stems are as tough as metal. It is almost impossible to break them and they are sawed with difficulty.

At certain stages of their growth the green stems can be split into slender pieces finer than a horse hair. This makes it specially adapted to weaving into innumerable kind of baskets, mats and wearing fabrics.

David G. Fairchild, agricultural explorer, says: "In addition to the use of the bamboo as food and plants their value from an aesthetic standpoint is incontestable. They are among the most graceful forms of vegetable life that exist,andadd an indescribable charm to any landscape. No one who has ever seen them in China or Japan can fail to have been impressed with their beauty or convinced of the great charm which they lend to the otherwise often monotonous character of the scenery. They are waving plumes of delicate green foliage, which, whether seen against the sky line or backed by a darker mass of forest, always give a peculiar softness to the scene.

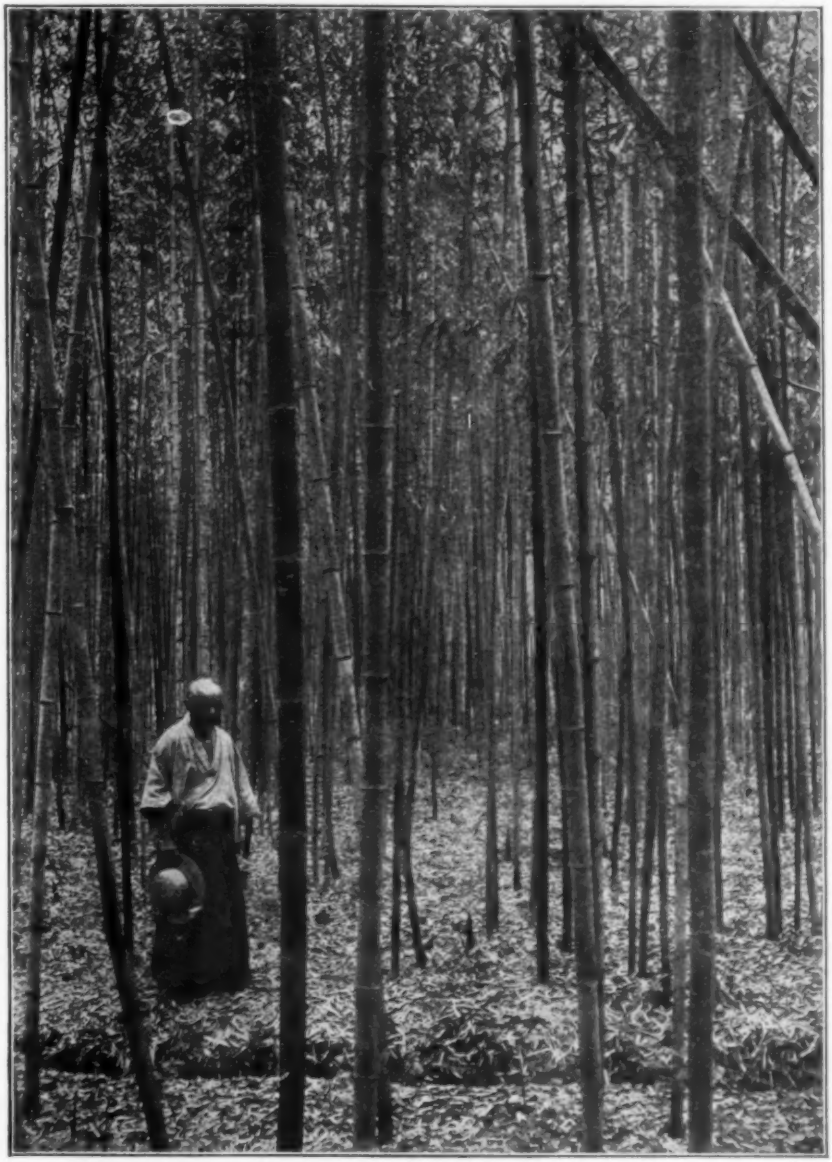
"Nearly every farmhouse has growing near it a clump of some one of the useful species, and the graceful mass of culms transforms what would be an uninteresting house into a pretty, picturesque home.

"It is, however, the introduction of the hardy representatives of this remarkable family of plants into the United States that should attract the attention of Americans, and the object of the government experts is to show how the various kinds of bamboo are cultivated in Japan, and to suggest how these methods of cultivation can be applied to American conditions."

The cultivation of the bamboo has been undertaken in California and resulted in splendid success. Dr. H. Tevis, of San Francisco, has the largest grove in America and one almost comparing to those of Japan.

Mr. Fairchild says: "There are in California, Oregon, Texas and throughout the Gulf

and Southern States thousands of suitable locations for the growing of bamboo. The banks of small streams, the deltas of rivers, low irrigated lands, like those in the San Joaquin and Sacramento rivers, would produce big forests of these valuable plants, while the banks of the irrigation canals wherever such occur in mild climates could be made beautiful by them. At Niles, Cal., Mr. John Rock has bamboos 20 feet high which are watered twice a year with about 2 inches of water each time."



Well-Kept Forest of Bamboo Growing on Good Soil, Showing an Open Drainage Ditch in the Foreground and the Thick Mulch of Leaves and Straw Which Cover the Ground. Age Probably Over 50 Years

It is believed that the bamboo could be made to thrive in the United States as far north as Washington.

The United States government has sent

special experts to Japan to view and study the growth of the various species of the giant grasses. The plants already sent to America have done well and thousands more are to be sent here and transplanted. Further information as to the efforts being made may be obtained on application to B. T. Galloway, chief of the Bureau of Plant Industry, U. S. Department of Agriculture.

Now that the cultivation of the bamboo has been successfully taken in the United States and that "Moso" or bamboo sprouts may soon become a common dish with us, it may soon be necessary that Popular Mechanics readers know how to prepare them. Here are some recipes given by Miss Fannie Eldridge, an American lady now residing in Oklahoma:

1. Bamboo sprouts with cream sauce.—These sprouts are cut when about a foot above the ground, by digging down to the rhizomes which bear them. After being gathered, the outside sheaths are removed and the shoots are soaked for half an hour in cold water. They are then cut in thin slices, about 3 inches long by 1 inch square, and thrown into boiling water containing a small teaspoonful of salt, and are boiled from an hour to an hour and a half, or until tender. The pieces are then drained and a white sauce is poured over them, which is made in the following way: To a half pint of cream or milk add a teaspoonful of butter; season with salt and black pepper. Allow this to boil up and serve at once. If desired, this sauce may be thickened with flour.

2. Bamboo shoots in butter.—Slice and cook as in the previous recipe, until tender. Into a saucepan put three tablespoonfuls of butter, seasoned with pepper, salt and a little chopped parsley. When heated, put in the bamboo. Shake and turn until the mixture boils; then lay the bamboo on a hot platter, pour the butter over it, and serve at once.

3. Bamboo shoots, Japanese style.—Slice and cook the bamboo until tender, as in recipe No. 1; then put into a sauce made as follows: Take one coffee cup full of soy sauce (this is the basis of Worcestershire sauce and obtained only at Chinese or Japanese grocers or at some of the largest groceries in our large cities), one-fourth cupful of water, one heaping teaspoonful of sugar; let boil for half an hour in this sauce, and serve.

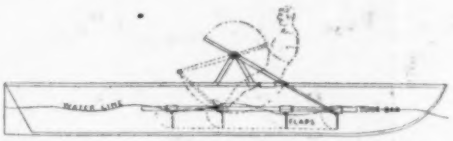
Bamboo is the best paying plant culture in Japan. It requires very little care and nets the growers as much as $50 to $90 per acre.

NEW ELECTRO-PLATING PROCESS.

A German has perfected an invention for silver-plating or gilding iron, steel, nickel and similar articles without applyng a preliminary copper coating. The articles are first immersed in an electrolytic bath, consisting of a solution of pyrophosphate of sodium, protochloride of tin, nitrate of aluminum and nitrate of magnesium. The object thus receives a preliminary coating with an alloy, and is finished off by electro-plating in the ordinary way.

A NEW BOAT PROPELLER.

A new means of propelling pleasure and hunting boats is described in the British Inventor. A series of "flaps," working on hinges with an action similar to a duck's foot when swimming, is placed on either side of the boat. A foot and hand lever

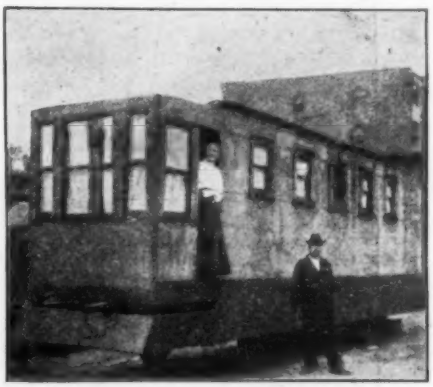


Oarless Boat

worked by the operator give these flaps a steady, silent motion and a high speed to the boat. For hunting the operator can lie at full length, being entirely hid, while moving the boat. The flaps do not catch in weeds and grass as do a pair of oars.

SLOWEST AUTOMOBILE IN THE WORLD.

Chicago has the slowest automobile in the world. Its greatest speed is not more than five miles an hour. Its owner is proud of its slow pace and with his wife lives in the house car. When they get tired of



The Snail Auto

one locality they start the gasoline motor and remove the house to another part of the city. The Automobile Review says the house car is 28 feet long, 6 feet wide and 11 feet high.

Important improvements in the Mississippi river are expected to result from the convention of the Mississippi River Improvement and Levee Association, held in New Orleans Oct. 27.

How to Measure the Velocity of Water

Measuring the flow of water so as to determine the velocity in feet per second is an interesting process which is accomplished by three different methods: The Weir dam method, the Miner's inch method and the method known as "Measurement by Cross Section and Velocity." The latter is only used when it is desired to approximate the water quantity and is not very accurate. The method is as follows:

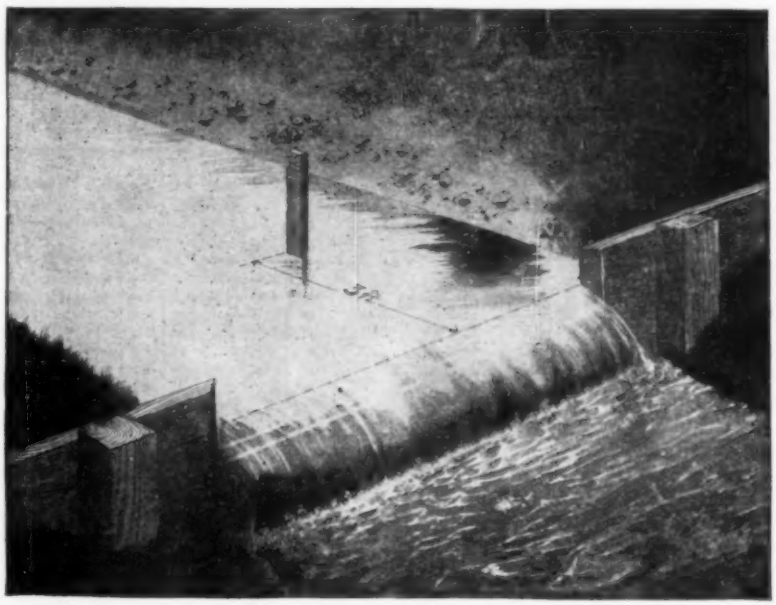
MEASUREMENT BY CROSS SECTION AND VELOCITY

Select a stretch on the stream or ditch which will afford as straight and uniform a course as possible. If the water is at any point carried in a flume it is better to measure at this point. Lay off a distance of, say, 300 feet; measure the width of flowing water at about six different places in this distance, and obtain the average width; likewise at these same points measure the depth of water at three or four places across the stream, and obtain the average depth. Next drop a float in the water, noting the number of seconds it takes to travel the given distance. From this can be calculated the velocity of the water in feet per second. The quantity is the product obtained by multiplying the average width in feet by the average depth in feet by the velocity, which (if in feet per second) will give the flow of the stream in cubic feet per second. From the figures so obtained it is advisable to deduct about 20 per cent, as surface velocity of the water is in excess of the actual average velocity.

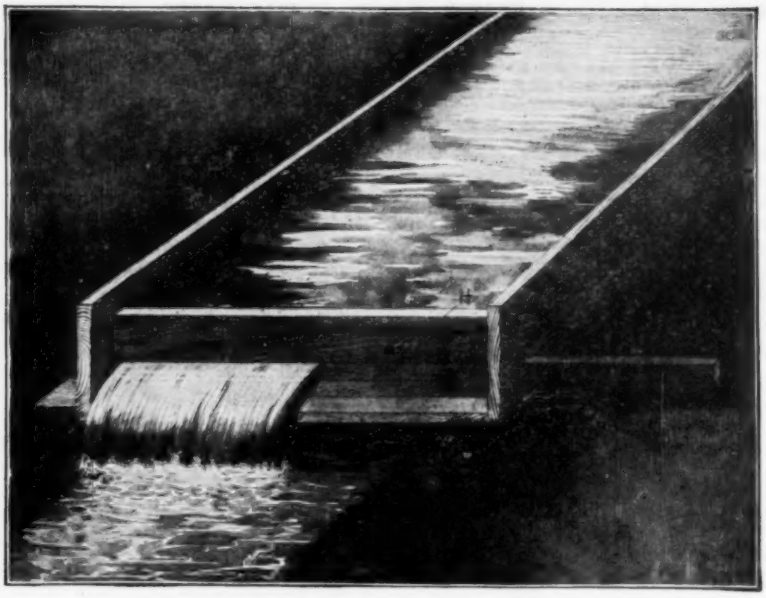
When the stream is of sufficient depth—three feet or over—the average velocity can be more closely obtained by using a pole, to one end of which is attached a stone or piece of lead of necessary weight to allow the pole to sink nearly to the bottom. In this way the velocities at the surface and the bottom of the stream counteract one another and a closer approximation of the average velocity is obtained.

THE WEIR DAM METHOD.

To measure by the Weir dam method is the most accurate and reliable and should be employed for close calculations. It is as follows: Place a board or plank in the stream, as illustrated, at some point which will allow a pond to form above. The board



Weir Dam Measurement



Explanation of Miner's Inch Measurement

should have a notch cut in it with its edge beveled toward the intake, as shown. The length of notch should be at least four times its depth for small quantities, and longer for larger quantities. In addition to the above it is advisable for very accurate measurements to have, when possible, the length of the notch about two-thirds of the width of the water on the up-stream side; it may be necessary to experiment somewhat in order to obtain this condition.

The overfall or vertical distance the water falls on the down-stream side, should be about twice its depth—that is, 12 inches if the notch is 6 inches deep, and so on.

In the pond not less than 3 feet, and preferably 6 feet, from the weir, drive a stake near the bank, with its top precisely level with the bottom of the notch in the weir; then measure carefully with a rule the depth of water over the top of the stake. This will give the theoretical depth of flow, corresponding to that in the table on this page.

In order to obtain accurate results it is essential that the velocity of water in the pond be extremely slow, and if the weir be constructed of proper proportions this condition will exist.

The following table for the weir measurement gives the cubic feet of water per minute that will flow over a weir one inch wide and from ⅛ to 20⅞ inches deep:

TABLE OF WEIR MEASUREMENTS.

INCHES.	⅛	¼	⅜	½	⅝	¾	⅞
0	.00	.01	.05	.09	.14	.19	.26	.32
1	.40	.47	.55	.64	.73	.82	.92	1.02
2	1.13	1.23	1.35	1.46	1.58	1.70	1.82	1.95
3	2.07	2.21	2.34	2.48	2.61	2.76	2.90	3.05
4	3.20	3.35	3.50	3.66	3.81	3.97	4.14	4.30
5	4.47	4.64	4.81	4.98	5.15	5.33	5.51	5.69
6	5.87	6.06	6.25	6.44	6.63	6.82	7.01	7.21
7	7.40	7.60	7.80	8.01	8.21	8.42	8.63	8.85
8	9.05	9.26	9.47	9.69	9.91	10.13	10.35	10.57
9	10.80	11.02	11.25	11.48	11.71	11.94	12.17	12.41
10	12.64	12.88	13.12	13.36	13.60	13.85	14.09	14.34
11	14.59	14.84	15.09	15.34	15.59	15.85	16.11	16.36
12	16.62	16.88	17.15	17.41	17.67	17.94	18.21	18.47
13	18.74	19.01	19.29	19.56	19.84	20.11	20.39	20.67
14	20.95	21.23	21.51	21.80	22.08	22.37	22.65	22.94
15	23.23	23.52	23.82	24.11	24.40	24.70	25.00	25.30
16	25.60	25.90	26.20	26.50	26.80	27.11	27.42	27.72
17	28.03	28.34	28.65	28.97	29.28	29.59	29.91	30.22
18	30.54	30.86	31.18	31.50	31.82	32.15	32.47	32.80
19	33.12	33.45	33.78	34.11	34.44	34.77	35.10	35.44
20	35.77	36.11	36.45	36.79	37.13	37.46	37.80	38.15

Table of Weir Measurements, Giving the Cubic Feet of Water Per Minute that Will Flow Over a Weir From 1-8 to 20 7-8 Inches Deep

For example: Suppose the weir to be 66 inches long, and the depth of water on it to be 11⅝ inches. Follow down the left-hand column of the figures in the table until you come to 11 inches. Then run across the table on a line with the 11 until under ⅝ on the top line, and you will find 15.85 This multiplied by 66, the length of weir,

gives 1,046.10, the number of cubic feet of water passing per minute.

MINER'S INCH MEASUREMENT.

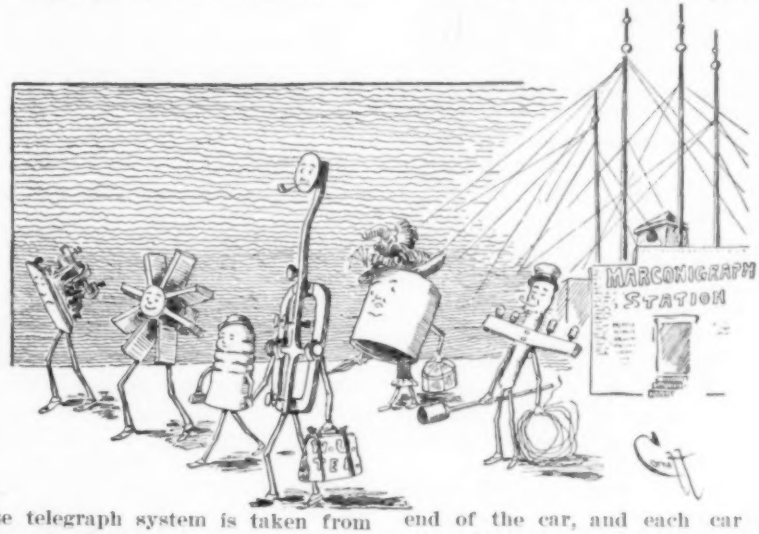
The term "miner's inch" is of California origin, and is not known or used in any other locality, it being a method of measurement adopted by the various ditch companies in disposing of water to their customers. The term is more or less indefinite for the reason that the water companies do not all use the same head above the center of the aperture, and the inch varies from 1.36 to 1.73 cubic feet per minute. But the most common measurement is through an aperture 2 inches high and whatever length is required through a plank 1¼ inches thick, as shown in the cut. The lower edge of the aperture should be 2 inches above the bottom of the measuring box, and the plank 5 inches high over the aperture, thus making a 6-inch head above the center of the stream. Each square inch on this opening represents a miner's inch, which is equal to a flow of 1½ cubic feet per minute. The element of time is not considered in the calculation of a miner's inch.

DOWNWARD PROGRESS OF STANDARD FREQUENCIES.

"Industrie Electrique" of Paris says: "The downward progress of the standard frequencies, made by alternating current engineers, is interesting to note. The periodicities of 133 or 128 that were taken as a matter of course 15 years ago have almost entrely disappeared and lie now between 16 and 40, except that where power only is transmitted the figure has been reduced to 25. This, however, is not to be the limit. With the heavy currents used for carbide making a little reactance has a great effect, and some furnaces have, in consequence, adopted a running frequency of 16. Alternating current series traction motors, which are now being tried simultaneously in Italy and the United States, require a frequency of about that figure, or even a little lower, and there are people who talk of going still further down. Difficulties which were quite insuperable at 133 are, of course, easily managed at 13 1-3.

BEGINNING OF THE END.

The following cartoon showing an exodus of the instruments and accessories of the Morse telegraph system is taken from the Railway Conductor.



During the past four years passenger travel on our steam roads has increased 35 per cent, while freight traffic gained 27 per cent.

IMPROVEMENT IN CATTLE CARS.

The Frisco line is experimenting with a new stock car. Doors are placed at each end of the car, and each car connected, when loading or unloading, with a gangway. An entire trainload may thus be filled from one chute from the cattle pen, as the cattle are driven through the pen to the car most removed. When full the doors are closed and the next one filled, and so on.

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AMERICA FALLING BEHIND IN SPEED.

People Blinded by False Reports—Worst Telegraph and Postal Service in Civilization.

American citizens are being a bit blinded by the exaggerated reports of record-breaking speed by American trains, electric cars, automobiles, etc. Half the people of the United States are led to believe from the reports given out by these railway officials, automobile manufacturers, and street railway authorities that we lead all the world in swift-moving trains and other devices of locomotion. But when it comes to an examination by actual comparison it is shown that we are getting to be nearly as far behind Europe in speed of traffic as we are in the matter of telegraphy and postal service, which an English tourist recently declared to be in the United States "things beneath contempt." It is good that we show our qualities without disguise occasionally lest we become subject to derision and unconsciously antiquated in our ignorance as to how far behind the world we are in some respects, an ignorance that many common carriers would willingly encourage—for improvement of service is costly.

America has many of the greatest things in the world, and many of the worst, among the latter of which is our telegraph, postal and express systems and our street pavements. It may be that our railways will enter this list if we do not keep pace with the rapid progress now being made abroad. The train schedules shown in English time tables show thirteen runs varying in length from thirty to 175 miles at an average speed of between 50.3 miles and 61.7 miles per hour. Three of the regular scheduled performances exceed 60 miles per hour. Some of the fastest runs are shown in the following table.

Company and run.	Miles.	Minutes.	Speed per hr.
Northeastern, Darlington to York	41¼	43	61 7-10
Midland, Appleby to Carlisle	30¾	30	61 5-10
Caledonian, Forfar to Perth	32½	32	60 9-10
Great Western, Bristol to Paddington	117¼	120	58 6-10
London and Northwestern, Birmingham to Euston	113	120	56 5-10
Great Central, Aylesbury to Leicester	65	69	56 5-10
Great Northern, Wakefield to King's Cross	175¾	190	55 6-10
London and Southwestern, Salisbury to Waterloo	83½	91	55

The American roads have no scheduled runs for like distances which equal the above. The nearest approach to them is shown in the following table:

Company and run	Miles.	Minutes.	Speed per hr.
Philadelphia and Reading, Camden to Atlantic City	57.8	60	57.8
Pennsylvania, Philadelphia to Atlantic City	59	60	59
New York Central, Buffalo to New York	440	525	50.28
Lake Shore and New York Central, Chicago to New York	980	1,200	48.996

The Bristol-Paddington train is now the fastest for its distance—117¼ miles—in the world, the Northern Railway of France having discontinued its Paris to Arras train.

One hundred miles per hour is not considered a high speed for automobiles to make in races in Europe, yet when America's automobiles make 60 miles an hour it is called a world's record. In Germany electric cars have regular schedules of 50 and 60 miles an hour. Our lines will not average half that rate. In the experimental railway between Marienfelde and Zossen in Germany a speed of 125 4-5 miles an hour was attained recently in a run of 14½ miles.

NEW STEAM TURBINE VESSELS.

Two of the four vessels ordered by the Midland Railway Co., of Great Britain, for its Irish channel service are to be propelled by engines of the turbine type. The four vessels are to be equal to a speed of 20 knots on a six hours' continuous trial; and as the size and tonnage of the vessels are to be similar, their operation will afford an excellent opportunity for comparison. Should any of the vessels fall short of the required speed by half a mile per hour, that vessel may be rejected.

"Airship" Proves a Good Submarine

Langley's Device Made Like a Bird, But Acts More Like a Fish --Its Trip Under Water

It looks as if the United States government in Prof. Langley's airship has discovered an excellent submarine boat. While the machine refuses to fly in the air it readily sinks itself in the water, and it is believed that by adding a sufficient amount of cork it could be made to rise to the surface of the water at will, equal to the best government submarine torpedo boats.

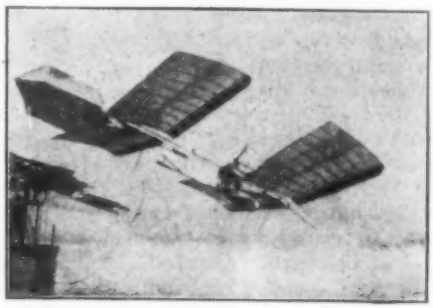
The airship was built on the model of a bird, but partakes more of the characteristics of a fish.

This diving or sinking quality of the learned professor's invention was discovered in the recent trials near Widewater, Va. The great 60-foot, 1,200-pound steel aerodrome, on which the secretary of the Smithsonian Institution had spent years of scientific study and $50,000 of the government's money, was brought forth glistening in the sunlight and placed on a 70-foot track 60 feet above the water.

Prof. Langley was away in Washington at the time and so Prof. Charles F. Manley occupied the place of Darius Green in this modern flying machine. When the device was ready for the test Prof. Manley started the gasoline motor and the propellers began to revolve at the rate of 1,200 times a minute. The great steel bird rushed forward to the end of the track, but only remained in the air as long as its momentum would permit. It went down from its 60-foot height about as rapidly as would a cannon ball hurled with the same force, and on striking the water began its wonderful diving performance that proclaims it a splendid success as a submarine boat. Prof. Manley, who started out to fly in the air, instead took his first trip under water in an enclosure. He sat in the navigator's car, situated close to the gasoline motor. The entire machine disappeared in the Potomac and the river currents surged and curled where it sank.

Those who looked on were thoroughly alarmed and feared for the safety of the professor in the navigator's car. But the airship was too good a submarine to endanger the life of its captain. The bridges of the machine quckly appeared above the water. Prof. Manley climbed up through the water from his navigator's car and a shout of joy went up from the multitude when his head showed above the waves. A boat had been rowed out to where the airship went down. It was in waiting when the professor had finished his dive and he was immediately taken aboard. He was conveyed to the tug Bartholdi and safely carried to shore none the worse for his journey. It was the five conical shaped floats distributed about the ship that established its value as a submarine. These caused it to lift itself to the surface of the river.

The United States government should make the necessary overhauling and permit the "airship" to enter the government submarine service. To do this it would be necessary to lighten the boat so that it would have more of a tendency to linger near the surface of the water than at the bottom, and to regulate the floats so that



The Langley Air Ship.

they could be raised and lowered, causing the boat to rise and sink at will.

The 27 horse-power gasoline motor designed to propel the car was of the explosion type and weighs 200 pounds. Long rods connected it with the propellers, whose blades were about three feet long.

There is talk of a congressional investigation into the failure of the Langley airship. As the $50,000 for its construction was appropriated by congress, some people are asking what basis there was for the supposition that the machine would be a success. Prof. Langley as secretary of the Smithsonian Institution, which is under government control, had many friends influential in governmetal affairs, and it is through them, it is said, that the appropriation was obtained. Inventors of other American airships are wondering why the government ignored their inventions.

EASY ELECTRICAL EXPERIMENTS

A WIMSHURST ELECTRICAL MACHINE.

Ordinary dynamos produce currents which, comparatively speaking, are of low voltage, or pressure. It is rare indeed to find a dynamo which is capable of causing sparks to pass across a space filled with air. In order to cause a spark one inch long to pass between two balls, a pressure of at least 20,000 volts is required.

Static electric machines, so-called, generate charges of electricity at much higher voltages than this. Of these, the Wimshurst is the best known and perhaps the most reliable. Although such machines have been built, capable of giving a spark many inches in length, yet the amount of current represented is very small indeed. The electric spark thus produced illustrates many important points. Lightning is nothing but an enormous spark, brought about by the difference of potential between the clouds and the earth.

A small machine, capable of giving in dry weather a spark two inches in length, is described below. The materials required are not hard to obtain, and the mechanical work is not difficult.

In Fig. 1 is shown a wooden framework for the support of the various parts. This should be made of well-seasoned maple or oak, and thoroughly mortised and glued together. The end pieces A and B are 2 inches square in cross section and 10 inches long. They are supported by wooden legs which are 2 inches in height. The pieces C and D are 13 inches long and 1½ inch by 1 inch in cross section. There should be exactly 3¾ inches of space between their inner faces. The uprights E and F are of the dimension shown in the figure at the left, and are made from ⅞-inch stock. On the center line of these uprights bore two holes. The upper one is 7 inches from the extreme bottom, the lower one is 1½ inches from the bottom, and the two holes are each 5-16 inch in diameter.

At R is shown one of two brass rods, of which the dimensions are given. The rod is provided with a shoulder, made by soldering a brass washer firmly to the rod. The longer ends of the rod are then pushed through the upper holes in the uprights, in which they should fit tightly, and are fastened in place by screws passing through the shoulders into the uprights.

It will next be necessary to make the pieces shown in Fig. 2. At F are two well-turned wooden pulleys, 4¼ inches in diameter, with a face which is ¾ inch wide, upon which is turned a groove ¼ inch wide and ⅛ inch deep. These two pulleys are to fit tightly upon a shaft shown at A. This shaft is made from 5-16-inch brass rod, and the length of shaft from the point where it bends into a crank to the end is 6¾ inches. The crank itself has a throw of 3 inches, and a handle 2½ inches long. The pulleys are pinned to the shaft, but should not be secured in place until the shaft has been slipped through the lower holes in the uprights E and F, Fig. 1.

At E is shown a hard rubber post, of which two should be made. They are

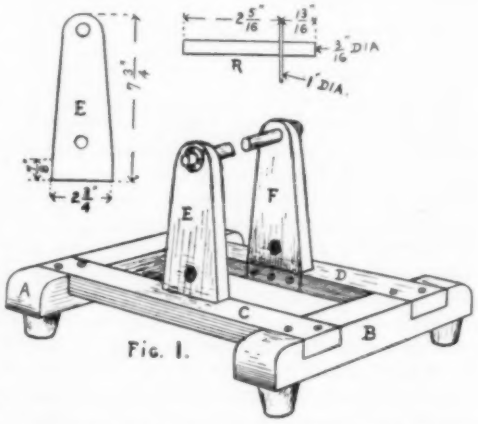


Fig. 1.

threaded at their upper ends, to fit the pieces of brass shown at C. The dimensions are given for these pieces, and their construction ought not to be difficult. Each one is made of two pieces of brass, soldered together. It is absolutely necessary that every rough corner should be smoothed and rounded, so that there are no minute points to allow escape of electricity. B is a brass thimble made to slip loosely on C, and A is a brass ball, well smoothed, which screws on C, and holds B in place.

The piece shown at D is of hard wood, and two of these should be made. They are designed to fit upon each of the horizontal pieces shown at R in Fig. 1, and to turn easily, but without "wobbling," upon them. For this reason they should be fitted with a brass tube through their cen-

ters, which just turns snugly upon the rods R. The necessary dimensions are given in the figures, except the groove, which is the same size as the groove in the large wooden pulleys below them.

At H is shown one of the collectors, of which there should be four. They are made by soldering a piece of thin brass to a brass rod 4⅝ inches long and ¼ inch in diameter. The thin edge of the brass is cut with a file into teeth which are to be sharp, but all other parts must be very smooth and free from sharp points or edges.

Referring to the complete machine, Fig. 3, we see several pieces which have not yet been described, but which can be made

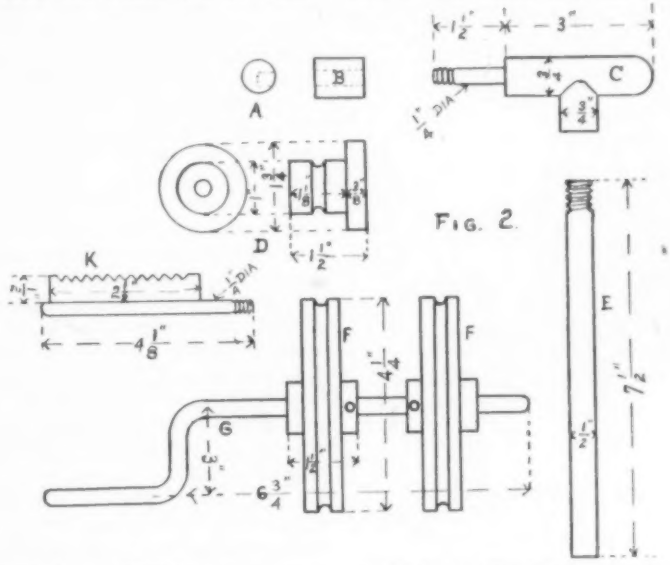


FIG. 2.

without recourse to a drawing. The uprights, it will be seen, support at their lower end the wooden pulleys, pinned upon their brass shaft, the crank of which projects towards the front. Above, these uprights support the horizontal rods (seen more clearly in Fig. 1), and upon these rods turn the wooden ferrules D, Fig. 2. These ferrules carry, on their inner sides, discs of hard rubber, each of which is 1-16 inch thick and 9 inches in diameter. If the dimensions given have been followed, there will be a clear space of 5-16 inch between the front and back discs, but of course they are free to turn independently. In cutting these discs they will work much easier if dipped frequently in warm water. They can be pressed flat by immersing them in hot water and pressing them between two flat surfaces. Each is secured concentrically to its wooden hub by small flat-head screws. Upon these discs, on their outer faces, are to be fastened with shellac 16 sectors of tin foil. These sectors are wedge shaped. They are 2½ inches long, ¼ inch wide at their inner end, and ½ inch wide at their outer ends. Their outer ends are ¾ inch from the outer edge of the discs. Round the corners of the tin foil sectors and shellac them smoothly and evenly in place, with their inner ends pointing directly towards the center.

The hard rubber discs are to be driven in opposite directions by means of belts passing over the pulleys below. The front belt is a straight one, the back belt being crossed. The belts should be of round leather and fairly tight. The whole should turn freely.

The hard rubber posts shown at E, Fig. 2, are mounted, one in each end of the frame and exactly in the middle. A screw passing through the end strips will secure the posts firmly in the holes. The upper end of each post carries the brass piece C, Fig. 2, the threaded end being turned away from the handle of the machine.

The collectors shown at H, Fig. 2, are mounted into the brass cylinder C at such a distance that they just clear the outer faces of the rubber discs, so that the latter may revolve very close to the collectors, without touching them.

The ferrules B are provided with two bent rods, each of which ends in a brass ball, and also with a rubber handle R,

which fits on a brass rod ¼ inch in diameter.

Below the support for the collectors are shown four condensers G, which are made from horse radish bottles, lined within and without, for two thirds of their height, with tin foil. The outer coatings are all connected by flat copper strips and the inner coatings of each pair are connected to C. A wooden ring at the bottom holds each bottle in place, aided by the support furnished by the brass rods passing through the wooden stoppers, and connecting the inner coatings to the conductors C.

One more feature needs to be described. At M is shown a brass rod bent into a semi-circle. It is supported at its center

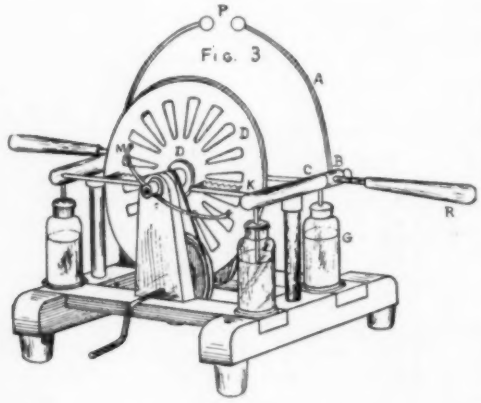


Fig. 3

by a brass thimble, slipping upon the projecting ends of the brass rod previously described, and its ends nearly touch the tin foil sectors on the rubber discs. On the ends are bound tufts of tinsel (obtained from an old telephone receiver cord), making very soft metal brushes which rub upon the moving tin foil sectors. On the back of the machine is mounted an exactly similar rod, except that it is placed at right angles to the front one.

The machine ought to excite itself readily when the handle is turned at a moderate speed. However, if unsuccessful at first, rub the rubber discs with a piece of fur.

Such a machine will give sparks 2 inches long, passing between the brass balls at P. The ferrules carrying the rods which support these balls should move with considerable friction, so as to stay in whatever position they are placed. Always use the hard rubber handles B when adjusting the position of the rods. Experiments with this machine will be described in the next chapter.

[To be Continued]

COMBINES PHONOGRAPH AND MOVING PICTURES.

An apparatus combining the phonograph and moving picture machine is being manufactured in Chicago. It is the invention of T. F. Solon, a former member of the Wisconsin legislature. This device threatens to elevate the slot machine to the realm of the theater. By dropping a nickel in the slot a person may see the actors move about on the stage and hear them speak their lines. The machine resembles the moving picture cabinets so familiar in the Chicago penny arcades. In the upper half of the case is the motion picture mechanism, and in the lower part the phonograph, so adjusted that every motion in the picture corresponds to the sound or speech, if any, in the phonograph below. A cylinder revolving at lightning speed carries the roll of pictures, while in the talking mechanism wax cylinders are automatically switched off and one as the scenes of the drama change above. The person who drops the nickel places the tubes from the phonograph to his ears and immediately is informed that he should look through the bullseyes above and see, for instance, the first scene of Hamlet. At the word you see the soldiers marching back and forth and hear the clank of their arms. Then they gesture and speak ominously of the apparition which has late appeared. Hamlet comes before your vision, then the ghost, and you hear it say: "I am thy father's spirit, doomed for a certain term to walk the night."

Or the picture cylinder may be replaced by another charged with stereopticon views, to be slowly revolved, and while you gaze upon the scenes of picturesque Europe the voice in the phonograph will say: "Now, behold upon your right the far-famed Mont Blanc, capped with eternal snow." You ascend the mountain, hear the crash of avalanches, peer into yawning crevasses, hear the cries of frightened tourists, all while you wait for your train at the depots or elevated station and all for a nickel.

The boiler pump of a passing steam automobile was used to extinguish a burning barn near Torrington, Conn. A garden hose was attached to the pump.

How to Make a Treasure Box

Seemingly Inexhaustible Receptacle of the Hindu Magician an Easy but Clever Trick

It is not difficult to make a Hindu treasure box, which to the onlooker seems to form an inexhaustible receptacle. The treasure box really consists of two boxes, one fitted closely inside the other. The magician makes no secret of the fact that it is made in two sections, one acting as a sort of shell for the other; in fact, he begins proceedings by taking the treasure box apart in order that the spectators can see both sections. The outside cover is open at one end so that it can easily be seen that it is empty. After the spectators are satisfied the treasure box is put together and then all sorts of sweetmeats, toys and other trifles are taken from it. At any rate, the treasure box may again be shown empty and immediately afterward the work of taking out treasures can recommence.

The Hindu magicians make their treasure box in two sections, because the spectators are grouped all about the performer in that country, consequently his work is viewed from every point.

If the spectators are placed only in front of the magician the outer section of the treasure box may be dispensed with.

Figure 2 shows the smaller or inside section drawn almost, but not quite, out of the larger or outside section.

Figure 1 shows two pieces of board fastened together at right angles.

The boards of which Fig. 1 is made must be of the same thickness as the boards of which the smaller section of the treasure box is made.

The two boards of which Fig. 1 is made must be exactly the same size.

A part is cut away from the back of the smaller section of the treasure box, as shown in D, Fig. 2. This must be just the size of one of the boards of which Fig. 1 is made.

It can be seen now that if Fig. 1 is hinged on each end of the line F to the bottom of D, Fig. 2, then when B, Fig. 1, swings down, A, Fig. 1, will form a back to the smaller section of the treasure box; and when A, Fig. 1, lies flat in the bottom of D, Fig. 2, B, Fig. 1, will form a back to the box.

The dotted square shown at B, Fig. 2, shows the position which B, Fig. 1, will occupy when A, Fig. 1, forms a back to the box, as indicated by the dotted line A, Fig. 2.

E, Fig. 2, is the lid of the smaller section of the box.

The bonbons, flowers, etc., are placed between the two boards A and B, Fig. 1. When it is desired to show the box empty the board B is allowed to swing back into the box C, Fig. 2.

The inside of the boxes is painted black, which makes it impossible to detect the presence of the double back.

If it can be arranged to have the spectators all in front the larger of the two boxes can be dispensed with, as its only use is to hide the board B when it is necessary to show the box empty.

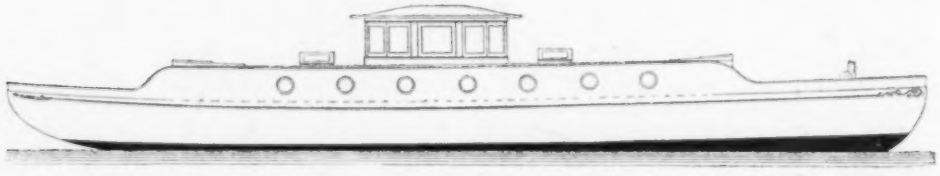
As the smaller section of the treasure box is kept facing the spectators, it would itself hide the board D, providing no one is behind the box.

If the larger or outside section of the box is dispensed with the magician, while he is showing the box empty and attracting attention to it with his right hand, may replenish the part B with his left hand

either from his pockets or from a shelf under the edge of his table. This enables him to make the apparent capacity of the treasure box as great as he chooses.

QUEEREST OF YACHTS IS THIS.

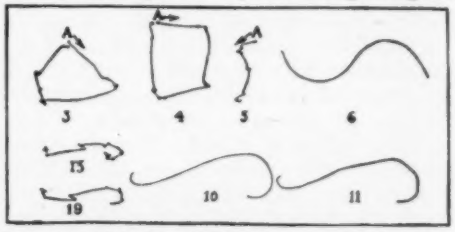
Like no other boat ever built is the new gasoline cruising yacht of J. A. Serrell, Bayonne, N. J., just launched at Bridgeport, Conn. The pilot house is of oval form and placed directly in the center of the deck, its floor being a platform 9 feet long, three feet wide, immediately over the motor, thus being about 2 feet 8 inches below the upper deck. Though intended only for the helmsman this room which is 10 feet long and 6 feet wide with windows on all sides, will make a very pleasant place in bad weather. It is reached by a short ladder from the engine room and all levers for the control of the motor are carried up by short and direct connections through the floor. The helmsman not only has a clear view of the entire horizon but he can easily step below to care for the motor or out on deck if needed there. The motor, a 25-horsepower, two-cylinder, occupies a length of 9 feet near the center of the boat, the space on the port side giving a galley and toilet room, while on the starboard side there is a passage fore and aft, and a wide, deep locker, making a comfortable berth by night. The forward cabin is 16 feet long, fitted with four permanent berths. The after cabin is 14 feet long, with wide transoms sleeping four very comfortably. The gasoline tanks are located aft and an ample supply of water for long cruises is carried under the cabin floors. The yacht is fitted with two long masts carrying leg-o'-mutton sails, with one jib. She will carry three boats on the davits. The hull is of the whaleboat type, sharp on deck aft, and the sides are carried up from the sheerstrake to form the sides of the cabin trunk, thus giving a deck 40 feet long and of an average width of over 12 feet, the height being about 6 feet above the water. The dimensions are: Length over all, 66 feet; breadth, extreme 13 feet 6 inches; draft, 3 feet 9 inches.



New Type Gasoline Cruising Yacht

HOW EYES READ FIGURES.

The eye moves in a very erratic manner in following the outline of a figure or letter. Its action is anything but graceful, darting from point to point along irregular lines. In reading this line your eyes will make four of five jerky movements instead of gliding along with a uniform motion.



Movements of the Eye in Following the Outlines of the Various Figures

Professor Stratton of the University of California has photographed the movements of the eye in reading numerals, as illustrated in the cut from the Keystone. The figures were 13 inches high and placed 32 inches from the face of the subject. The dots and heavy lines show where the eye hesitated before moving to the next point. The letter A shows the starting point and the arrow the direction followed.

Professor Stratton says: "The eye moves far less accurately over an outline than has usually been supposed; it takes a course which is but a round approximation of the form which we perceive. The eye darts from point to point, interrupting its rapid motion by instants of rest. And the path by which the eye passes from one to another of these resting places does not seem to depend very nicely upon the exact form of the line observed. The eye may take a short cut that is nearly or quite a straight line while 'following' the segment of a circle, as in some portions of Fig. 3."

Steamer Makes Trip Overland

The Twin Screw "Josie" Hauled Eight Miles Along Dirt Road by Two Traction Engines

Overland trips by steamship is a new reality brought about by the traction engine, that wonderful machine that is performing so many feats that would have seemed impossible a few years ago. Recently the "Josie," a twin screw steamer of 50 tons burden, was hauled over a dirt road from Alpena, Mich., to Long Lake, a distance of eight miles, by two traction engines, one of 16 horse-power and the other of 25 horse-power. The boat while in transit with the two powerful engines rolling her along is shown in the illustration kindly furnished by J. A. Hopper of Alpena.

Ship Being Hauled Over a Dirt Road

Mr. Hopper says the trip consumed about three days. All along the route people thronged to see the remarkable spectacle of a steamship moving along a dirt road.

Strange Mammoth Rock in Washington

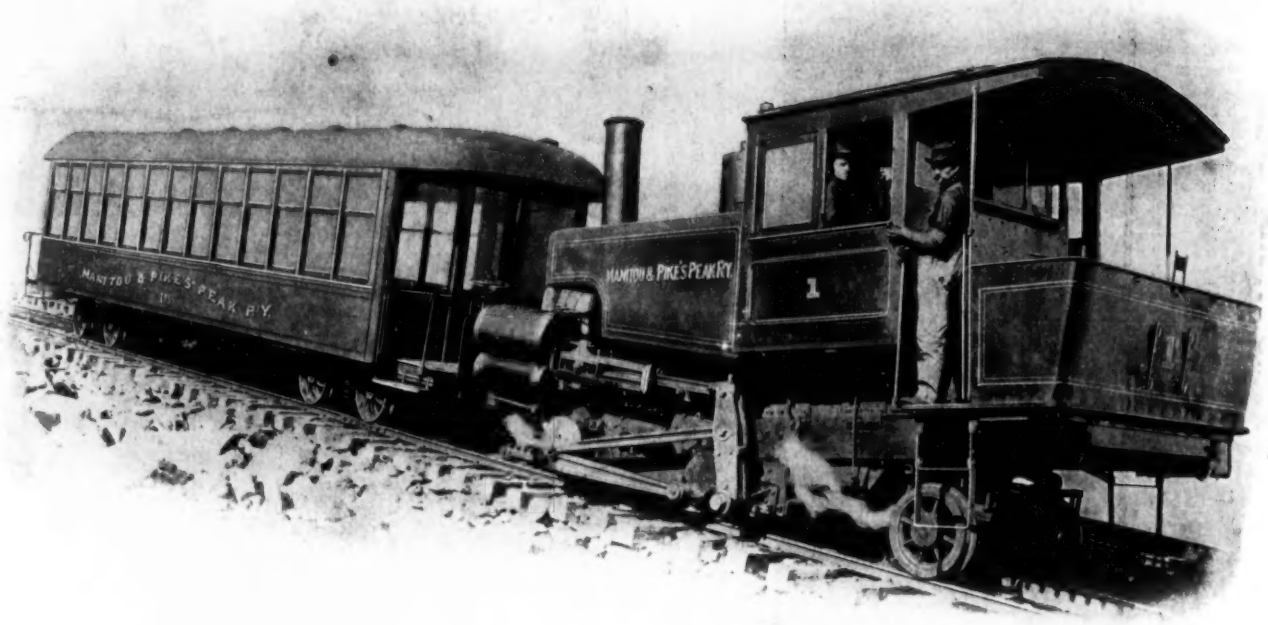
"Cabbage Rock" it is called, and that is a good name for it, as the "natural freak" resembles nothing so much as a great petrified cabbage. Scientists are now interesting themselves in the huge and wonderful formation, trying to account for its strange shape. On its seemingly insecure foundation, looking as though a man's arm might dislodge it, the rock has stood for untold centuries, defying the fierce gales that often sweep through the mountains in the state of Washington. No man has ever been able to account for the shape of "Cabbage Rock." Some wonderful cataclysm, some volcanic eruption, or maybe the erosions of time have left it as a monument to the handiwork of nature for men to marvel at for all generations.

The formation is composed entirely of basalt. The rock poised on the small neck would weigh many hundreds of tons if it could be dislodged.

It stands just across the great Columbia river from the Dalles, in Klickett county, Washington. The rock is perfectly poised on the narrow, slender, pivot-like base.

Cabbage Rock, Washington

Locomotive That Climbs Pike's Peak



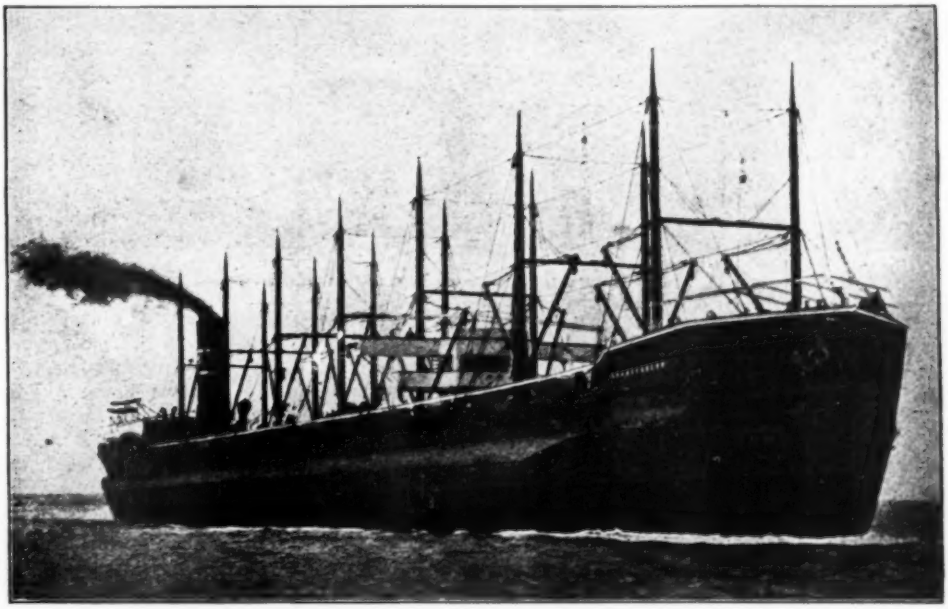
Manitou & Pike's Peak Railway

Queer Engines of the Pike's Peak Railway

The locomotives that climb Pike's Peak are odd-looking contrivances built by the Baldwin works especially for the purpose. Mounting inclines that often reach as much as 25 per cent grade, or a rise 1,325 feet per mile, these locomotives have a duty to perform unlike any other steam engine in the world. The ordinary locomotive could never ascend this mountain's side, and if started down the track from its precipitous top, despite all its air brakes and its reverse lever, it would be dashed to destruction at the mountain's foot. A number of these locomotives are in service on the Manitou & Pike's Peak Railway.

The laws of gravity fix a limit to the grade or incline on which a locomotive by adhesion alone will do satisfactory work; after this limit is reached other means of propulsion must be resorted to. Hence the method of operating the locomotives on Pike's Peak is by the introduction of a rack rail in addition to the two carrying rails of the track. Suitable gears on the driving axles in conjunction with the rack give the required propelling force. What is known as the Abt system of rack rail is used on this line.

Freight Steamer with 14 Masts

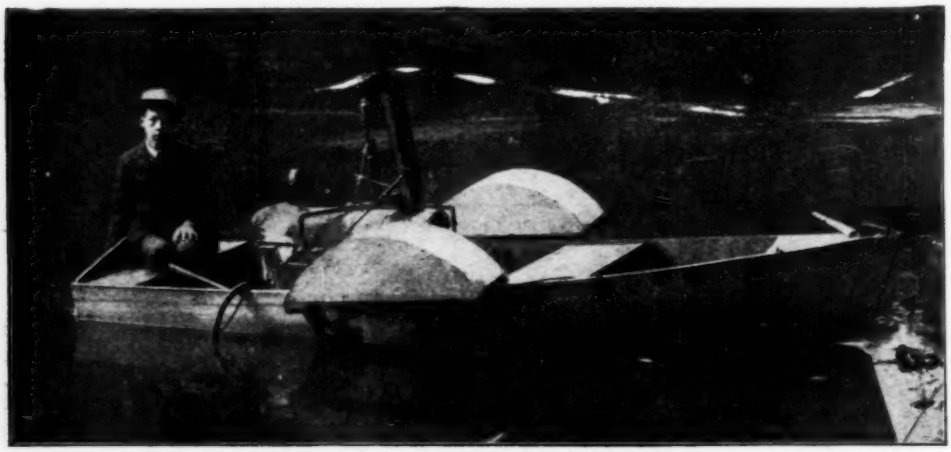


Fourteen-Masted Ore-Carrying Steamer Grangesberg

One of the queerest looking ships afloat has just been put in service for a big iron company in Sweden. The ship which carries 10,300 tons of ore was built in Rotterdam. It is 440 feet long, 63 feet beam, and has 2,200 horse-power with which a speed of 11 miles an hour is made. The ship has 14 masts, seven on each side, carrying 24 derricks. There are no between decks, and the space for ore is divided into 24 compartments. There is thus provided one derrick for each compartment and the entire cargo can be loaded, lifted and discharged in 30 hours.

Boy Builds Steamboat and Automobile

In his little steamboat, all of his own construction, William Webb Davis, Jr., just 16 years old, is the envy of every boy in Madison, N. J., when he rides about on the picturesque Passaic river, often accompanied by his sweetheart. The boat is merely the latest of young Davis' mechanical achievements. He also has an automobile which he built himself. He has a boiler and engine and all its appliances which he finished in three weeks on plans of his own invention.



William Webb Davis, Jr., in His Steamboat Built by His Own Hands

Following is the boy's description of his steamboat:

First I made the boat 12 feet long, 3 feet 6 inches beam. The sides are cypress and the bottom is white pine. The bow and stern have water-tight compartments. The paddle wheels do not come below the bottom of the boat, because the Passaic river is very shallow in places. The paddle wheels and paddle boxes are removable, thus making it easy for transportation. The boiler is made of 8-inch wrought iron pipe. I had a piece two feet long with a cap on each end and then drilled holes for the piping. The boiler jacket is made from sheet iron covered with asbestos which also makes the firebox. The motive power is an upright engine of about one horsepower connected to the paddle shaft by a bicycle chain. I made a small check pump with a piece of half-inch brass pipe for cylinder and two half-inch checks. This pump not only forces water into the boiler against steam pressure but also acts as a bilge pump.

I am now using wood for fuel, although I made gasoline burners and used them for a while. The boiler is equipped with steam gage, safety valve and whistle.

The exhaust steam from the engine goes up the stack to make a forced draft. At the end of the boiler is a water glass showing the amount of water in the boiler.

The boat may be steered by a person in the bow by means of a lever connected to the rudder with ropes.

TO PROTECT FRENCH WORKMEN.

"La Metallurgie" of Paris says: "There is a law in France intended to prevent, as far as practicable, the stationing of workmen in the plane of rotation or dangerous vicinity of a flywheel, grinding-wheel, or other heavy piece of machinery revolving at high speed. However, the Association of French Industrials has come to the conclusion that further security than that stipulated by the law is urgently called for. The association has now opened an international competition for the design of a protective covering to guard against the flying of fragments from all sorts of artificial grinding-wheels, grindstones not included.

VEGETATION KILLED BY FUMES.

Strong fumes from the immense gold and silver ore smelter at Trail, British Columbia, are wafted for miles up and down the Columbia river and through the surrounding country, half-stifling the employes at the smelter and the residents of the vicinity. The destructive effect of the outpourings of the smelter may be seen by dead trees, bushes, shrubs and vegetation of all kinds, which cannot withstand the deadly fumes.

The accompanying photo shows the huge smelter, which is one of the greatest of the northwest. Thousands of tons of ore are roasted here daily and made ready for use.

Showing Devastation Wrought by Smelter Fumes

TEST EFFECT OF ACTUAL BOMBARDMENT ON MODERN WARSHIP.

Experiments to ascertain the effect of the actual bombardment on modern warships were recently made at Brest, France, the battleship Massena firing on the Suffern, which is said to be the finest cruiser in the French navy. After firing three trial shots at the improvised targets which had been erected aboard the Suffern the Massena sent the fourth one directly at the turret, which it struck. The turret apparently stood the test well.

During these tests the officers and men of the Suffern were at their posts, but during the bombardment by the Massena sheep were imprisoned in the turret during the firing to test the intensity of the shock when the turret was hit.

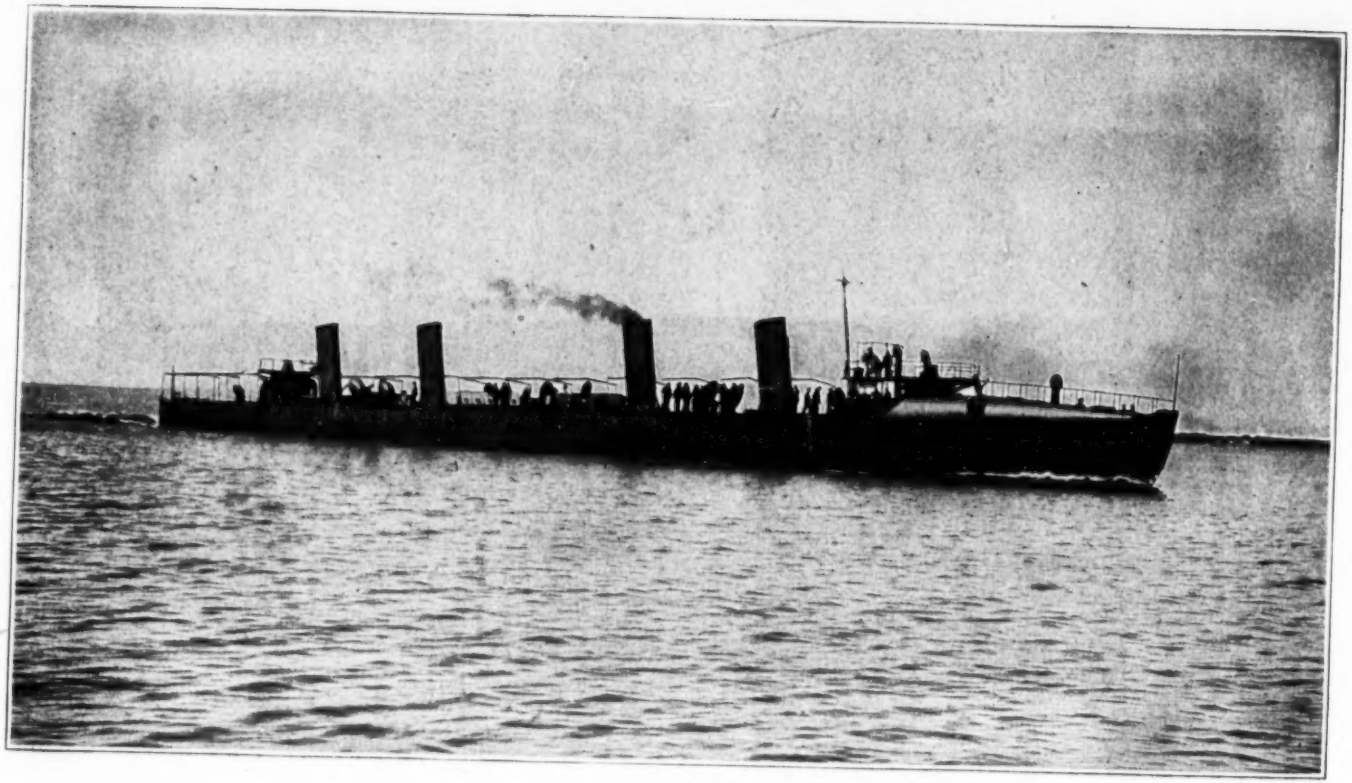
All shipping was prohibited from entering the zone of fire while the tests were going on.

The Massena took a position at 7 o'clock in the morning 160 yards from the Suffern. Torpedo boats kept the neighboring seas clear of vessels. Drums on both warships beat to quarters at 9 o'clock; a few minutes later the flag of M. Pelletan, minister of marine, was hoisted on the Massena, showing that he was aboard. The first projectile fired passed over the Suffern and struck the rocks on the other side of the bay, raising a huge cloud of stones and dust. The second shot was directed against a special target fixed just above where the turret of the Suffern was to be hit. The shell passed through the target and buried itself in the cliff beyond.

The range having thus been obtained, a big gun was trained against the turret itself. The flash from the gun was seen, the dull report of the discharge was heard, and almost immediately the heavy thud caused by the projectile hitting the turret. The shell rebounded and burst into fragments about 100 yards from the Suffern. All the watchers ashore could see the large, black blotch spread over the central turret. The actual damage done is not to be revealed, every precaution having been taken to keep it secret.

The result of Canada's digging of canals has been the diversion of grain trade from Atlantic ports of the United States to Montreal. The fact that in Canada the canals are frozen up during a great part of the year has not been a sufficient inducement to cause the Canadians to rely solely upon railroad transportation, and they are now reaping the reward of their courage.

America's Most Costly Torpedo Boat Destroyer



U. S. S. "Hopkins"

Destroyers of Destroyers

Two Deadly New Boats Added to the United States Navy

"Destroyers of destroyers" would be an appropriate name for the two powerful new twin-screw boats that have just been added to the United States navy. They are the "Hopkins" and "Hull," probably the most formidable and successful torpedo boat destroyers ever built in America. While of smaller size and displacement than most of the vessels of their class, the Hopkins and Hull cost more than any other destroyers ever built for the United States navy. They were constructed by the Harlan and Hollingsworth Company, of Philadelphia, at a cost of $291,000 for each vessel, exclusive of the cost of articles supplied by the government, such as ordnance, ordnance stores, a portion of the equipment and other outfit. This addition would probably bring their cost up to about $350,000 each. While this price is small in comparison to the cost of a battleship, it is unusual for a torpedo boat destroyer. The highest contract price ever paid by the government before for such a vessel was $286,000.

Every detail of the Hopkins and Hull is designed for deadly work in battle. They have a guaranteed speed of 29 knots an hour and are of 7,200 horsepower each. Each is equipped with a secondary battery of two 3-inch rapid fire guns, 50 caliber; five 6-pounder rapid fire guns, 10 6-mm. rifles; 73 38-caliber revolvers; one 45-caliber rifle; four mark I, 5-meter torpedoes; two central-pivot torpedo tubes and four warheads. Each is provided with two 20-foot cutters and one 20-foot whale boat. They have a length over all of 248 2-3 feet; beam (load water line) 24 1-3 feet and depth of 14.46 feet.

For nearly the whole length of the engine and boiler space, the vessels have a double bottom varying from 4 feet 3 inches to 8 feet 7 inches broad. The space thus formed is utilized for feed-water tanks, one being placed on each of the four compartments. The metal of the hulls is principally of mild steel of domestic manufacture; but the sheer strake and the top strake of the bunkers on each side are of nickel-steel. The main deck extends completely fore and aft and on it are built the forward and after conning towers. Each tower carries a gun platform and an extension aft of that on the forward tower is used as a bridge, having a steering wheel, compass and searchlight. On the main deck are placed the lighter guns, torpedo tubes, various chests and the boats.

There are two vertical, inverted, four-cylinder, triple-expansion engines, the port engine being in the forward and the starboard engine in the after compartment.

Describing the trials, a naval expert in the Journal of the Society of Naval Engineers states: "Never in any of the trials had we any accident to any one on board, or were we held up by any bearing getting hot, with the doubtful exception of the first trial of the Hopkins, when two pieces of steel, which should never have touched, threatened to fire. This is only one indication of the great excellence and faithfulness of the crew which ran these trials, almost all of whom were there from first to last. In spite of the heavy overweight she had to carry the Hopkins is one of the few destroyers, authorized at the same time, which have reached their original contract speed, and one of the very few which have considerably exceeded it."

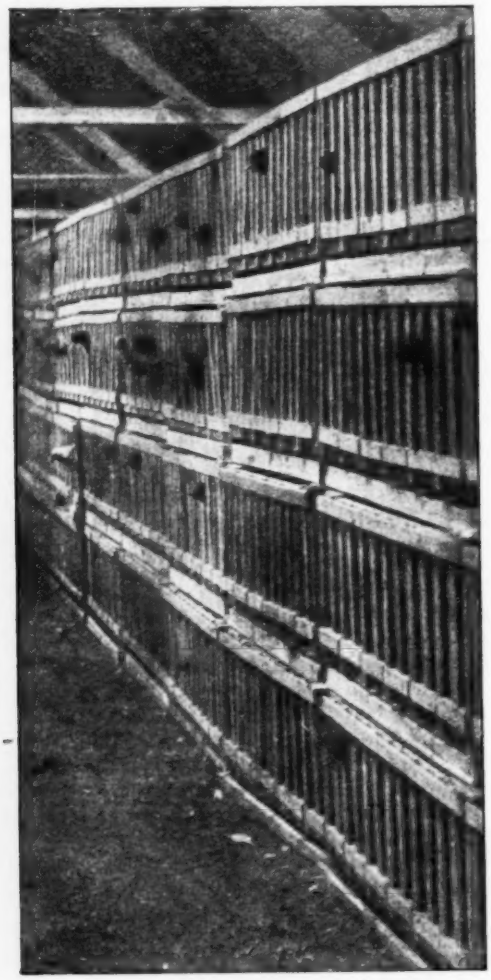
ODD ACCIDENT IN CHICAGO RIVER.

The coal steamer Charles Stewart Parnell while steaming up the Chicago river recently loaded with 3,000 tons of coal became a victim of one of the oddest accidents in the history of marine navigation. A section of the steel propeller of the outgoing steamer Northland was driven through the solid oak of the Parnell's hull and buried in her coal cargo. The danger was not discovered until three days later when a coal hoister was burrowing in the dark depths of the ship's hold. Then for the first time the officers and crew realized by what a narrow chance the Parnell missed going to the bottom of the river and blockading the stream of navigation. Carpenters were hurriedly put to work and all haste made to remove the coal remaining in the vessel when it was found that the injury was above the water line. Meanwhile the Northland, the biggest passenger ship afloat on the lakes, had steamed to Buffalo, her crew and passengers ignorant of the boat's part in the remarkable accident.

Feeding Poultry by Machinery

A Method Already in Use in Europe, but New in the United States

The demand of the age is to produce results in the shortest possible time, and to accomplish this some mechanical process is usually employed. The poultry raiser is no longer content to wait the slow process of nature to grow and fatten a fowl, so he uses a machine which feeds the bird as much in a few seconds as it would eat in two hours. Chickens and turkeys do not have to chew



Tiers of Coops

their food, the main thing is for them to get outside of a goodly portion and then sit down to digest the mass.

A New England poultry man by the name of Allen, has invented a machine for feeding or "cramming" fowls. The poorest, thinnest birds are chosen and placed, one in a coop, and the coops piled up in rows four tiers high. The food is selected and a

The "Stuffer" at Work

machine loaded. Then the operator starts at one end of the row. Taking out the first victim he holds it under his arm with the left hand, and with the right thrusts a tube down the bird's throat into its crop. Then he presses a lever with his foot and instantly the fowl is fed. Then it is put back in the coop, and the crammer goes on to the next one. The theory of confinement is to prevent the bird from losing flesh by an active life, and the machine takes the place of the most vigorous appetite. Weight is secured in half the usual time and the meat is more tender.

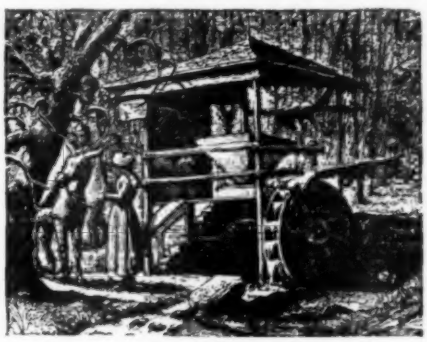
AUTO CLIMBS A LOFTY PEAK.

T. P. Driver, of Melrose, Mass., and F. H. Peabody, of Boston, Sept. 13, made the first ascent of Mount Washington in an automobile. They used a four horse power gasoline runabout. The actual running time was three hours and twenty minutes. Mount Washington's height is 6,286 feet and the distance by road about twelve miles.

All ships of the German navy have miniature models of themselves on board. The model can be taken apart and it is possible to examine any piece of machinery or to look under the boilers without having to wait until the fires are drawn.

SMALLEST AND MOST ANTIQUATED MILLS.

The smallest mills in the world are in North Carolina. They are the grist mills such as were used during the civil war and are yet found in abundance in the woods at the foot of mountain streams. Nowhere else in America could machinery so primitive be discovered. The mills are built of undressed logs held together by wooden pins. They rarely consist of more than a frame and roof to protect millstones from the weather and sometimes even the roof is lacking. A small mountain stream is in some instances brought to the mill by way of a trough and employed to turn an overshot wheel, but often they are built directly over the stream so that the water turns the wheel as it flows underneath. The grain is brought to the mill on horseback, as the mountain roads are not the kind that one would desire to traverse in a vehicle. The woman of the family usually goes to mill. She rides astride a horse or mule, carries a sack of corn in front of her as



An Old Carolina Grist Mill

she journeys along the dark, wooden mountain roads, puffing away contentedly at a corn-cob pipe.

Emil Berliner, inventor of the telephone transmitter, has constructed and, he declares, successfully tested a flying machine, built on the principle of the aeroplane, which will enable human beings to fly through the air. The apparatus consists of an equipment like the wings and tail of birds.

What is believed to be the deepest air-lift of water is in operation in a mine at Cambria, Wyo.

MOST POWERFUL SEARCHLIGHT IN THE WORLD.

Throwing a beam of light that is blinding to a person standing within its path,

World's Greatest Searchlight

a searchlight that has just been made in Germany is the most powerful in the world and the most skillfully constructed. The light has 360,000,000 candle power. It has an iris shutter 6 feet in diameter. The light is electrically controlled by two levers, one of which controls the motor mounted in the base of the searchlight which operates the projector in a vertical direction through a chain of gears. The other lever starts or stops the electric motor which controls the horizontal movements of the beam of light. The iris shutter makes the projector perfectly light-tight at any moment desired. It operates similarly to the type of shutter as applied to modern cameras.

A NAIL-LESS HORSESHOE.

A nail-less horseshoe is the latest. The shoe is provided with metallic straps which rise to a common point near the top of the hoof. These straps are hinged to the shoe, and connected at the ends by a threaded bolt, which can be turned with a small wrench to clamp the straps over the hoof.

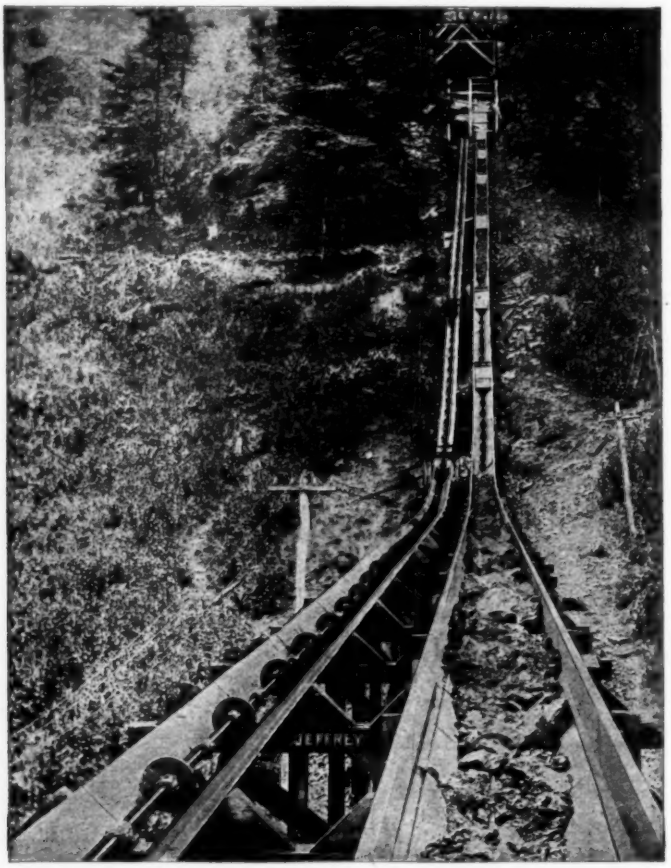
The United States Steel Corporation has bought Mesaba iron ore lands of Minnesota which it is estimated contain 70,000,000 tons of ore. The purchase price is said to be $70,000,000.

CHINA WATER PIPES IN GERMANY.

China water pipes have made their debut in Germany. They cost considerably more than the iron and stone pipes, but possess many advantages. The pipes are very thin and glazed and are inclosed in iron pipes, the space between the two substances being filled up with cement. China, being the best resisting pipe material known, every guaranty is given for an unlimited life of the pipes. The absorbing of iron in the water is made altogether impossible. Iron pipes by having particles of iron absorbed by the water will corrode in the course of time, forming hydrated oxides of iron (Eisenoxydhydrate) which will stop up the tubes and finish by eating holes in the pipes. China pipes with the average diameter of ordinary water pipes cost about $714 per mile at present. They are made by the Meissen China Factory in Saxony.

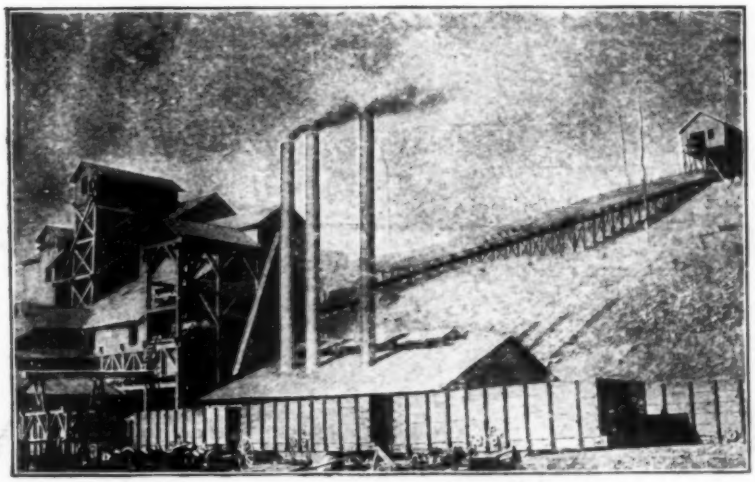
HANDLING OF COAL GREATLY CHEAPENED.

It seems strange that with all the modern machinery for handling the product of the mines, coal should be higher now than it was under the antiquated system of a decade ago. Mining and handling coal has been greatly simplified within the past three years through important inventions, to which the city of Columbus, O., has been an important contributor.



Retarding Conveyor

The retarding conveyor, shown in the illustrations with its late improvements, saves the coal man many thousands of dollars each year. The conveyor is operated in connection with a modern coal washery. The washery, shown in the picture, is equipped with three 400-ton Jeffrey-Robinson washers and has a capacity of 1,600 tons in ten hours. The retarding conveyor has a capacity of from 125 to 200 tons per hour.



Jeffery Coal Washery in Connection with Retarding Conveyor

With it there is absolutely no breakage of coal and the work is done systematically with very little manual labor.

KEEPS HORSES FROM SCARING.

A folding blinder, which can be dropped down over the horse's eyes like a spring curtain by merely pulling a cord, has been invented by a Nebraskan as a means of controlling scary and vicious horses. The presence of the blind is never obtrusive when hidden away in a casing over the brow-band of the animal's bridle. The blinder comprises the casing or housing curved to conform to the brow-band and fastened to the bridle by suitable straps. This contains a bellows folding curtain or blind which is normally held in place within the casing by means of spring clips. The curtain is operated by a cord secured to the lower ends of the curtain and passed through the bit rings and then back to the saddle or hip-straps of the driving harness, within easy reach of the rider or driver. The moment this curtain is drawn down in front of the horse's eyes he becomes quieted and can be secured and led away from danger.

The main difficulty in all wire constructed guns, says Fielden's Magazine, is the provision of longitudinal strength in order to overcome the tendency to bend—so common in all long guns.

PHONOGRAPH IS POLLY'S NEW TEACHER

Teaching parrots to talk is the newest office of the phonograph. In this capacity it saves a great deal of labor on the part of the owner and the parrot seems to enjoy the instructions. The trumpet is directed to the "student" and the machine is turned on. Polly sits there in most respectful attention and the constant repetition of words enables the bird to pick up the language faster than parrots acquire it by the old method.

Polly's New Teacher

A Georgia woman has invented a safety pin and sold the patent which will pay her $6,000 a year for 17 years. She also receives a royalty on sales.

Spinning Wheel and Distaff of Olden Days

Civilization's Oldest Companion Gone

The spinning wheel of olden times has gone. With it passed an avocation almost as old as history. In no other respect has modern mechanics made so radical a transformation in the customs and habits of people. Not long ago a familiar sight in every Southern and New England household, and in the homes of Ireland, Scotland and many other parts of the world, the spinning wheel and distaff in actual use can now scarcely be found outside of Ireland. There its employment has been temporarily revived by the new demand for Irish homespun, one of the finest cloths that is made. The royalty and nobility of Europe are now wearing the garments from the yarn spun at the Irish woman's spinning wheel.

The distaff was a necessary adjunct to the old spinning wheel. It was a staff for holding a bunch of flax, tow or wool from which the thread is drawn in spinning by hand. In its simpler form this method of spinning was in use by the old Greeks and Romans and is mentioned in Old Testament times.

English women were first taught the use of the distaff and wheel by Anthony Bonavisa, an Italian. The spinning wheel was in use till the middle of the 18th century.

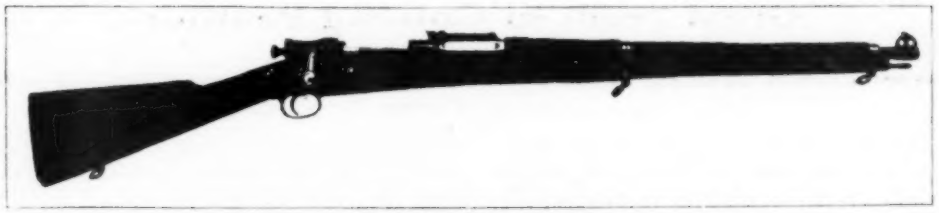
HOW TO DESTROY FLEAS.

Place common sticky fly paper on the floor of the room infested, and in the center of each sheet a small piece of fresh meat. The fleas will jump towards the meat and adhere to the paper, and in this way even a badly infested house can be rid of the pests within a day or so.

"What is that number on his motor-car?"

"Why, Jennie, that is the number of his machine."

"Indeed! I thought it was the number of people he had run over."



New Gun That Shoots Five Miles

The Most Powerful Rifle Made

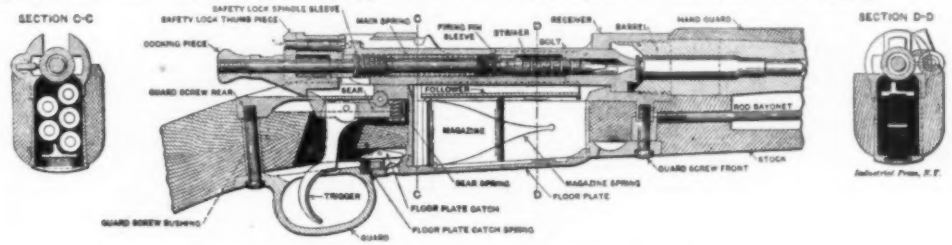
New Springfield of the Army Will Go Through 55 Men in Line

Little longer than a military carbine, but powerful enough to mow down 55 men in a line, the nearest man standing 53 feet from the muzzle, the new Springfield rifle, recently adopted by the United States army, is the most formidable shoulder arm in the world. It will shoot five miles and has the greatest penetrating capacity of any rifle used by any nation, being far superior to the old Krag-Jorgensen, the Mauser or the Service magazine rifle. Shooting at a range of 1,000 yards, the maximum ordinate of the trajectory is only 20.67 inches high. That is to say, in a distance of 3,000 feet the parabolic path of the bullet curves upward less than 21 inches above the straight line connecting the muzzle and the point of impact. The initial velocity of 2,300 feet per second gives the projectile a penetration of 54.7 inches of white pine, the targets being composed of 1-inch boards one inch apart and located 53 feet from the muzzle. The energy required to penetrate the fleshy part of a man's body is about equal to that required to penetrate a 1-inch pine board.

The total weight of the rifle, including bayonet and scabbard, is less than 9½ pounds. It is only 43 inches long. This length enables the arm to be used by both the cavalry and infantry. It is expected that it will be adopted by the navy department as well, thus equipping all branches of the service with the same weapon and using the same ammunition.

In the new Springfield the bayonet is reduced to a mere pike or rod bayonet. This rod normally lies underneath the barrel in the position ordinarily occupied by the cleaning rod or the ramrod of the old muzzle-loader. When required for action the bayonet is pulled part way out until a catch engages a circumferential groove. It is believed that with the general use of smokeless powder, which makes close encounters practically impossible, the bayonet will eventually be totally discarded from the military rifle. The magazine holds five cartridges. The gun can be used as a single loader by cutting off the magazine.

The construction is simple and strong. Two lugs are provided on the bolt, instead of one, to resist the breach pressure. The location of the magazine does not impair the balance of the arm, and, being entirely concealed, it does not detract from the appearance. In fact, the lines of the new gun are nearly as pleasing to the eye as those of some sporting rifles. The barrel is 24 inches long and is entirely encased in a wood sheath, the object of which is to prevent the heating of the barrel, due to rapid firing, interfering with the handling of the piece. The uniform protection of the barrel also prevents unequal radiation and consequent deflection of the barrel, which would result in inaccurate shooting.



Sectional View Showing Details of Breech Mechanism

Great Profit in Coining Pennies

Government Makes Enough From Them to Pay Cost of All Other Coins

The United States government makes enough profit from the coinage of pennies to pay the entire expense of operating the mints in making all the other metallic money used in the nation. No more copper cents are coined; the pennies are now made of bronze, a mixture of copper and tin. The total expense of the mintage system last year was $1,910,390. The seignorage, which is the difference between the value of the copper bullion and the value of the pennies after they are coined, was $1,919,370, leaving a balance of $8,800 in favor of the pennies.

Pennies issued from the mint last year numbered 87,376,722, which is about the annual average. There was great demand for pennies a few years ago when the stores had a fad of marking their goods 99 cents, 49 cents, 74 cents, etc., instead of the multiples of five. The mints were kept busy night and day and there was a call for pennies from all parts of America. With the passing of this craze among the better class of stores, however, the unusual demand has ceased. Now the slot machines act as regulators. Men who run them deposit the pennies in the banks every day or at regular intervals, which keeps a supply on hand. A great demand for pennies some years ago was caused by the reduction in the price of newspapers.

Like other coins, pennies reach the public through subtreasuries and banks, and are passed over the counters on application. However, they will be shipped from the mint to those who apply in large quantities.

Last year 87,000,000 pennies went into circulation. Of these New York state received 10,000,000; Illinois 7,000,000; Ohio and Pennsylvania 6,000,000 each and Massachusetts 5,000,000. There are now outstanding 1,372,630,221 pennies, many of which have probably disappeared into the oblivion which swallows up the pins. Since the government was organized there have been coined 1,517,326,068 pennies, of which 138,696,847 have been remelted. The government has stopped remelting them now, because it is cheaper to buy fresh strips of bronze and make them from new metal.

When things used to be cheap, many years ago, half pennies were coined, but that time is fast being forgotten. There are yet 7,895,222 of these half cents outstanding. Most of them are believed to be held by coin collectors. There, also, used to be issued a large clumsy 2-cent piece. Of these coins 28,717,414 are still outstanding, but few of them are ever seen.

Three-cent pieces made of silver, originally, but afterward of nickel, were coined years ago. There are 20,930,519 still outstanding, though none of them has been coined since the Civil war. Last year 31,480,579 nickels were coined and issued, making a total of 385,072,052 now outstanding. This is about 45 for every man, woman and child in the United States, but it is believed that many of them have also gone into the unknown hiding place with the lost pennies and pins.

MOVING BREAKFAST TABLES IN TRAINS.

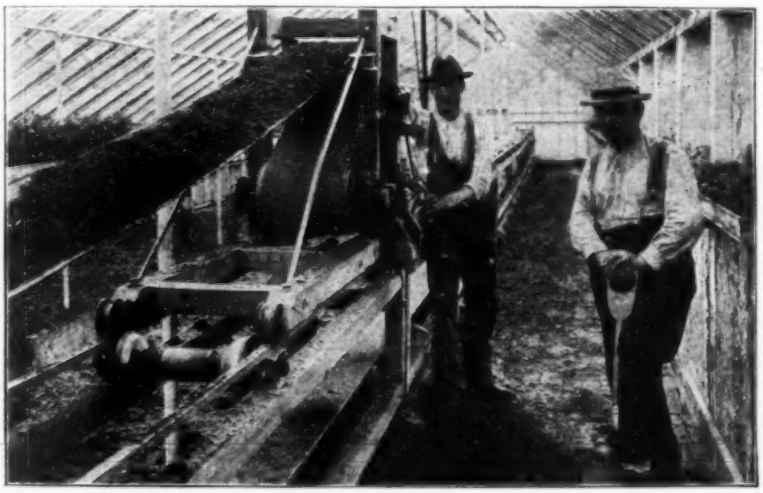
Raise the curtain of your sleeper and the breakfast, smoking hot, is there all ready before you. It is served from a movable dining table which passes through the entire length of the train serving breakfasts to people who prefer to eat before going through the ordeal of donning their apparel in the sleepers.

The moving table or "traveler" as it is called is about 5 feet long and somewhat narrower than the width of the coach aisles. They have already been installed on the Louisville & Nashville railroad and are meeting with such wide-spread approval that they will probably be adopted by all the leading roads. The coffee is kept steaming hot and served direct from gigantic urns which have been specially modeled for the work. On one end of the "traveler" is the urn of coffee, kept heated, just as it is in restaurants. On another end is an urn of the same size, filled with boiled milk. Between the two urns are sandwiches, each wrapped in waxed paper, and stuffed eggs. On a lower shelf the tableware, cups and saucers and icecream freezer are kept. There are two white-coated, white-capped, aproned servitors in charge of the "traveler" and, beginning at the forward end of the train, they attend to the wants of everybody aboard, passing from car to car.

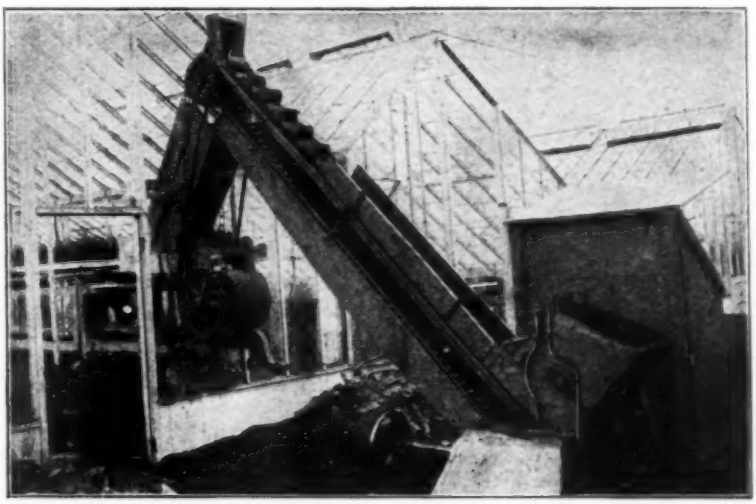
Machine Empties Greenhouses

Rapidly Conveys The Dirt Out and In and Saves Time and Labor

No more carting of dirt in wheelbarrows in modern American greenhouses; no more employing large forces of men for days in changing the soil for the flower beds. A soil-carrying machine has made its appearance, and the burden of the greenhouse keeper is lightened many fold. Instead of in wheelbarrows the soil is now carried on an endless belt. A "tripper" deposits the soil on benches wherever desired; a reversible elevator both fills and empties the houses, and can be reversed in ten minutes; a grinder and mixer crushes the small rocks and throws out the large ones, preparing the soil in any desired state, fine or coarse. In emptying the dirt is deposited

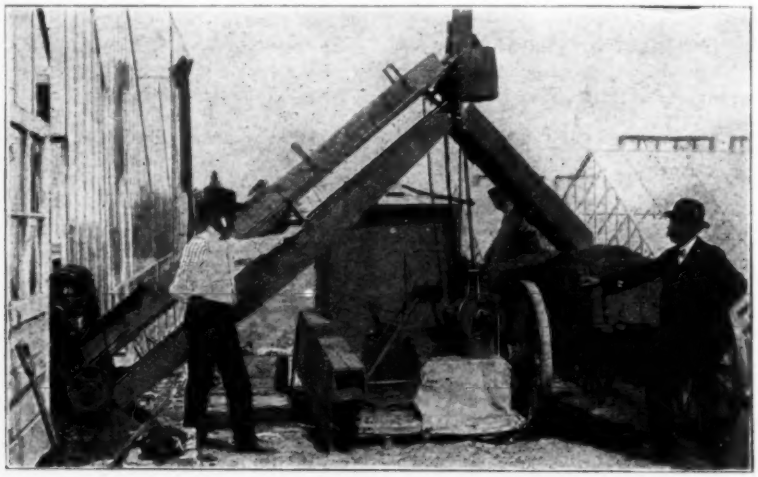


The Tripper is Moved as Soil is Deposited on Benches. (The Men Are Standing on the Brick Bottomed Bench)



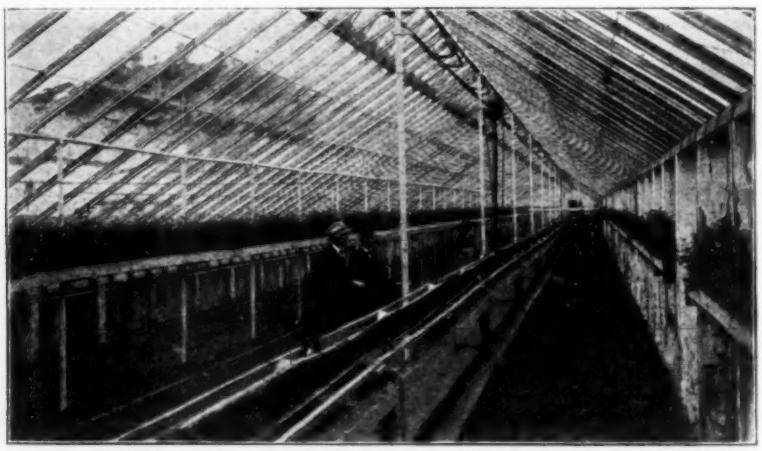
Crusher and Elevator on Soil Carrying Machine

directly into the wagons, making it necessary to handle the soil but once in this process. In short this machine seems to do all the work of changing the soil in a greenhouse save the little effort required to spread out the dirt over the benches and to shovel the soil into the endless belt.



Soil Conveyor Discharging Directly into the Wagons

The Florists' Review says: "The machine is operated by an electric motor, although gasoline or steam power will answer the purpose just as well. The machine is portable throughout and is built in sections of ten feet, so that two men can handle and carry them easily. It is adapted to fit any length or width of house, having side conveyors for wide houses, and will drop the soil just where it is wanted. The 'tripper' runs on a railroad of 1-in. square iron. One man operates and moves along rapidly as the desired amount of soil is deposited in the beds. The hopper also runs on the railroad and is moved along as desired. It is twelve feet long and five men are used on each side, taking the entire house as they go. The hopper is fitted with a grinder and mixer, used when filling the houses. This is a roller four feet long, cast solid, with heavy dull teeth. Ordinary stones do not affect it; they are broken and ground up, while if a big stone gets in it is readily released by springs with which the sides of the hopper are fitted. The soil is made



Soil Conveying Machine Used in Lake View Rose Garden

fine or coarse by setting the spring on each side of the hopper. It is then carried in the buckets up the elevator and dumped down the chute on the belt which carries it on to the 'tripper.'

"Houses three hundred feet long and thirty-five feet wide can be emptied with the five men on each side of the hopper in three and one-half hours, and to fill it takes only four and one-half hours. It usually took a day and a half for each operation with a much larger force of men."

Emptying Benches with Soil Carrying Machine

LAUGHED AT THE FIRST ICE MAN.

David Robinson was the first ice man in Portland, Me., and one of the first in the United States. In 1817 he housed five cords of ice or about 15 tons. On one of the warmest days of the following summer he drove through the town with a load of ice for sale and people all laughed at him in wonderment. He sold only two pieces and they brought but 6¼ cents each. He continued to fill his ice house, however, each winter after that year, the ice being mainly for his own use, until some ten years later, when he resumed the sale to the public. It was not until 1840 that ice came into general use in Portland.

On October 15 there were 2,000,000 cases, containing 720,000,000 eggs, in cold storage in the United States.

When you read Popular Mechanics you are doing something worth while.

NAVY WANTS SHIP CARPENTERS AND "WIRELESS" ELECTRICIANS.

Ship carpenters are desired by the United States navy to fill a number of vacancies. The pay is $1,300 per annum at sea, $1,000 while on shore duty, and $800 while on leave or waiting orders. The pay is increased every three or five years until after 15 years it is $1,960 per annum. When at sea carpenters are allowed 30 cents additional per day as ration money. They are many opportunities for technical study and information that may lead to important advancements. Persons desiring to compete for the position of carpenter should make application to the chief of the Bureau of Navigation, Navy Department, Washington, D. C., and mention Popular Mechanics.

Uncle Sam also wants more "wireless" electricians in the Navigation Bureau. The pay is $30 a month at the start and advances to $60. The candidates are required to have a working knowledge of telephone, measuring instruments, call bells and similar apparatus, but familiarity with ordinary telegraph instruments is not an essential qualification. Applicants after enlistment are to be especially trained on naval vessels.

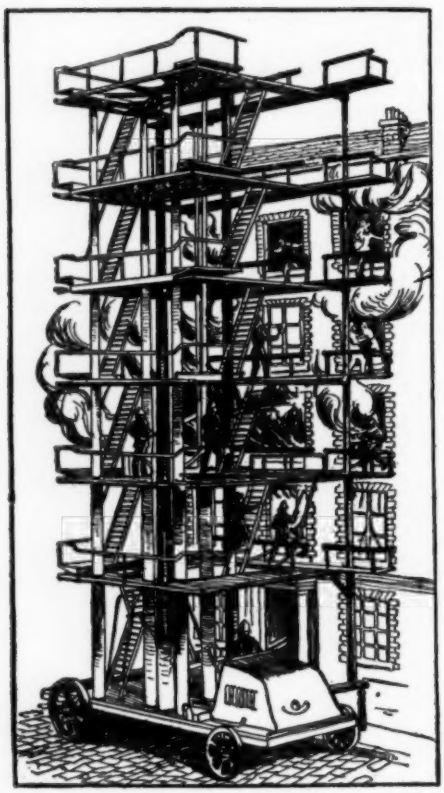
Premier Combes has instructed the annulment throughout France of all ordinances which limit the speed of automobiles unless the ordinances apply to every other kind of vehicle.

Growth of Industrial Art

This is the fourth of the series of illustrated articles being presented by Popular Mechanics on the growth of industrial art. After laborious research and considerable expense the publishers have been able to obtain pictures and data describing the evolution of all the important mechanical devices that make up our present day commerce. All these devices, as the articles will show, had their beginning in crude conceptions. The description and illustrations of these will be of intense interest to those of inventive minds, as showing the quaint creation that probably merely furnished the idea of which the present useful device is the outgrowth. Many of the "progenitors" of our modern machines were little more than toys. Many of them were ridiculed even by people of their day and their inventors held up to derision. But the principle on which they were based led to important discoveries that often have revolutionized the industrial world. Even now many such originals are being born every day, most of them to receive jeers or mere passing notice, but probably to figure conspicuously in the world's industry in after years.

The reader will doubtless appreciate that it was a search of world-wide scope that enabled Popular Mechanics to obtain the illustrations and data contained in this series. Libraries of foreign lands and numerous historical archives and private collections were searched in the effort. For our success we are indebted for the assistance rendered us by the London Institution of Civil Engineers, the "Centralblatt der Bauverwaltung," of Berlin, the French "Societe des Ingenieurs Civils," of Paris, the American Society of Mechanical Engineers and the American Society of Naval Engineers.

Fire Escapes of Many Forms



Latest London Fire Escape

The earliest recorded fire escape is the English Hoist of 1667. In 1784 Daniel Maseres of England invented a machine which being fastened to a window would enable any one to descend to the street without injury. Fire escapes have since been constructed of many forms and of every possible material. There are the familiar iron ladders attached to windows reaching to the tops of our modern 20-story skyscrapers; there are metallic and canvass chutes down which people are supposed to slide when the building catches on fire; ropes with hooks and loops, in which persons are to tie or hang and lower themselves from the burning structure. There are portable ladders to be carried in trunks and satchels; nets fastened on poles to be hoisted up to windows; nets for persons to jump into. Some of these may be useful and in many instances accomplish great good, but it rarely happens that any one in the upper stories of high buildings with a fire surging beneath, is collected enough to follow the instructions which make these fire escapes of value.

The future and most sensible fire escape will be attained when laws are enacted which will provide two or more fire proof stairways in every large building where there are many people congregated.

The accompanying illustration shows the latest of many fire escapes that have ap-

peared from time to time. It made its appearance in London a few days ago during the Earl's court exhibition of fire appliances. It is a large motor car which carries a series of platforms with mechanical means of raising them to a great height. While such a device might be practicable in London where the buildings are low it would doubtless be a difficult matter to provide enough platforms to enable it to rescue persons from the top stories of modern American skyscrapers of from 12 to 29 stories high.

1. English Hoist—1767. 2. Balcony—1791. 3. Lazy Tongs—1840. 4. Escape Ladder, United States Patent—1867. 5. Hoist, United States Patent—1868. 6. Tower, United States Patent—1878. 7. Hoist, United States Patent—1883. 8. Escape Ladder, United States Patent, 1884. 9. Portable Friction, United States Patent—1884.

For use in London the machine is intended to be swiftly driven to a burning house and at once extended so that the platforms are on a level with the upper windows. The occupants whose escape by the stairway has been cut off by the flames can then step from the windows directly onto these firm elevated tables, and can easily descend to the ground by means of the light steel ladders.

One of the most novel features of the invention is the clever device by which the platforms are extended lengthways to the width of the house on fire, so that exit is easy from any window.

In addition to forming an escape the engine is provided with a pumping arrangement, and from the various balconies the

firemen would be able to direct streams of water into the rooms far more effectually than they would from the street level.

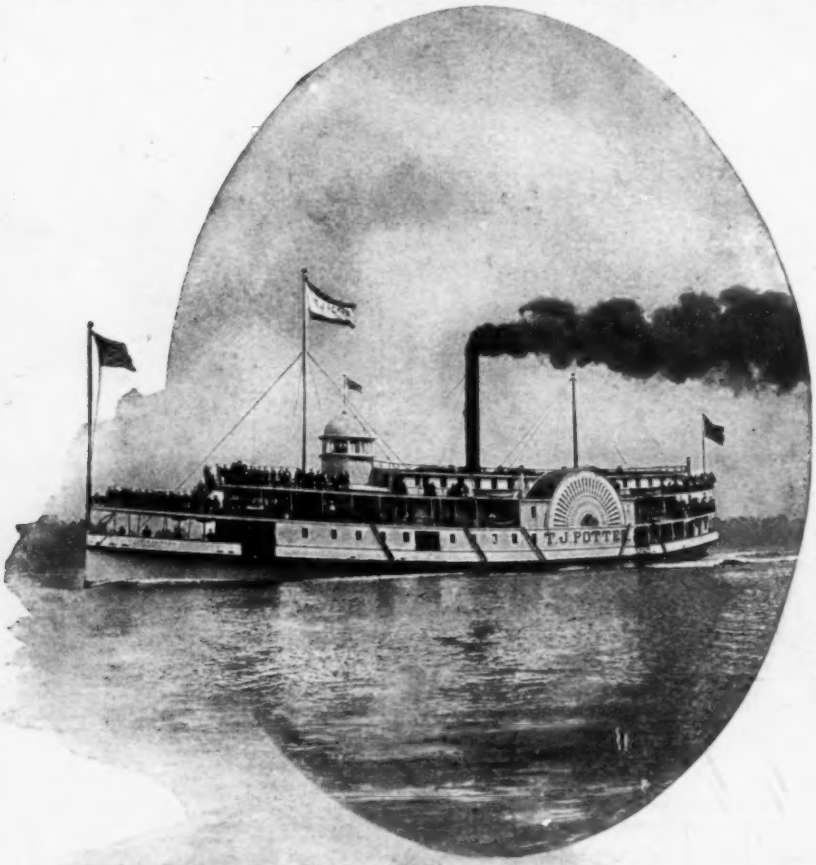
From the high platforms the firemen would, where necessary, be able with the greatest ease to enter through the windows, dragging the hose after them, thus quickly reaching the real seat of the fire, and bringing all their resources to bear upon it.

The invention has been patented all over the world. The actual size of the appliance is about equal that of an omnibus.

The Texas Railway Commission has given informal instructions to the effect that separate dining cars for negroes and white people must be provided on all Texas railroads.

ON THE PICTURESQUE COLUMBIA.

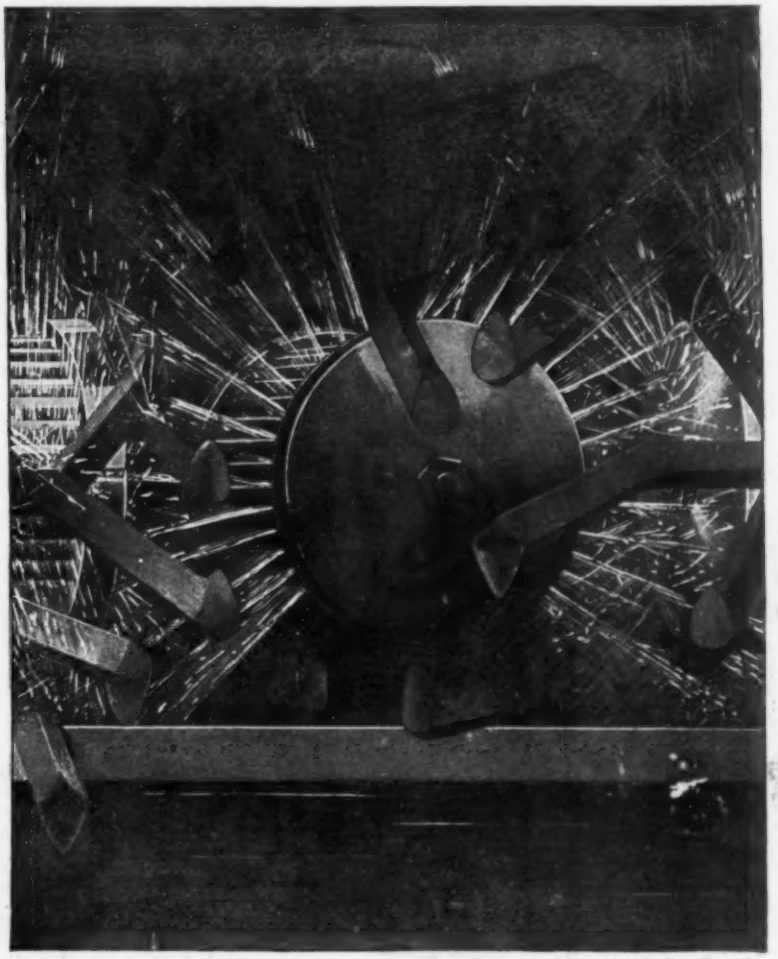
Cruising along the picturesque Columbia river, the boundary line of Washington and Oregon, is one of the most delightful sports to be found in America. So famed has the river become for its scenery that boat excursions along its course in and out of Portland, Ore., have grown wonderfully in favor recently. People have gone from all parts of the United States to traverse the river of the world's finest salmon and scenery. Most of the Canadian river excursion steamers are owned by the Oregon Railroad and Navigation Company. The T. J. Potter, operated by this company, is said to be the fastest and most elegantly fitted river steamer on the Pacific coast.



The T. J. Potter Cruising on the World Famed Columbia River

Strenuous Performance of a Filter Strainer

Throwing powerful jets of water in every direction, breaking up the caked refuse of filtration, scattering the fragments violently, and washing away every particle of foreign substance, the new method of cleansing filter beds employed by the Scaife system is one of the most strenuous and effective operations contrived. When the process is finished the filter bed is as clean as a rock-bottomed creek that has been scoured by a flood or a Kansas plain swept by a cyclone.



Washing Out Filter Bed

The caked matter is that which remains on the outside of the patent brass filter strainer. The filtering materials are especially selected for filtering out all the fine precipitate and suspended matter in the water. It is absolutely impossible for the water to cut channels through the filter and permit the fine particles to pass through. The reverse is true when the reverse current is applied in washing out the filter bed. It is then that streams of water are turned loose in the cleansing process. In this operation no stirring devices are required, no perforated discs, slotted plates or wire screens. Nothing more is needed when the strainer has finished its work.

Machine Unloads Rails While Train Moves

Lifts Them From Cars With Fixed Sides by Means of Compressed Air

Not only does this car unload rails from gondola cars, with fixed sides and ends, but it unloads them while the car is moving along. It is a pneumatic unloading device that was recently invented by an eastern roadmaster. Nearly all the laborious work formerly required in unloading rails for track repairing and new track is obliterated by the new device which is called the Ware pneumatic rail unloader. The machinery is operated by compressed air. Men are not required to do any part of the lifting.

End View of Ware Pneumatic Rail Unloader.

The Railway Review says: "In operation suspended tongs are attached to either the head or base of the rails, whichever is most convenient for grappling, and the rail is raised to a sufficient height to allow the men to guide it onto the roller attached to the upright and the roller at the head of the skid. The air is then released, the tongs detached and the men start the rails on the roller toward the skid. When the center of the rail reaches the roller on the skid the rail tips up, the end of the rail slides to the ground, and, as the train moves, the upper end of the rail gradually reaches the ground without damage to the rail or risk of its rolling down an embankment. The rails are landed on the ends of the ties, just outside of and clear of the service rails without further attention after they enter the skids."

The machine for unloading rails from cars with fixed sides is of special advantage in that rails are commonly shipped in such cars. In many of them it is impossible to remove the sides or ends and there has long been a sore need for just such an invention as the roadmaster has produced.

RUSSIAN TRUST IS A FAILURE.

"Birzhevia Viedomosti" (Exchange Gazette) of St. Petersburg, Russia, says: "The Russian Girder combine is approaching a crisis, owing to the absence of solidarity among the constituent firms. Lately numerous offers of second quality girders have been made at a quotation which is seven copecks under the price agreed upon by the syndicated firms. On the other hand, tests have failed to show the slightest difference between the 'second' quality and the usual quality on the market. In other words, the syndicate is being undersold by its own members."

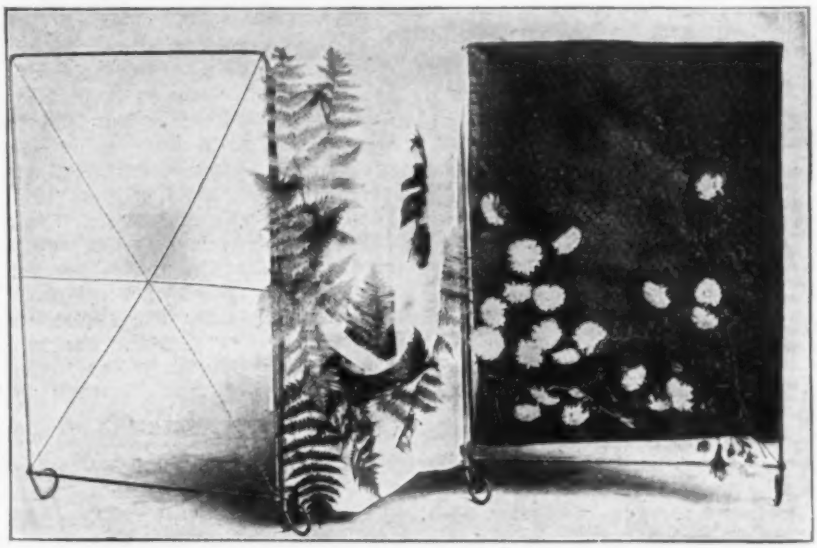
ICE BOAT FOR COMMERCE.

An ice boat for commercial service has been invented by a Michigan man. It is intended to carry passengers regularly during the winter. The boat will be balanced on special pivoted runners.

Decorating Panels and Screens

They Make the Best and Prettiest Backgrounds--A Design of Smilax

Panels and screens afford the most practical and beautiful decorative backgrounds. As many kinds of material as there are screens are all the better. The covering should be removable, for sometimes it is desirable to form a solid background and at other times a light semi-transparent effect is better. When covering is to be retained plain (not figured) goods should be used.



Screen, One Section Covered with Plain Burlap Background

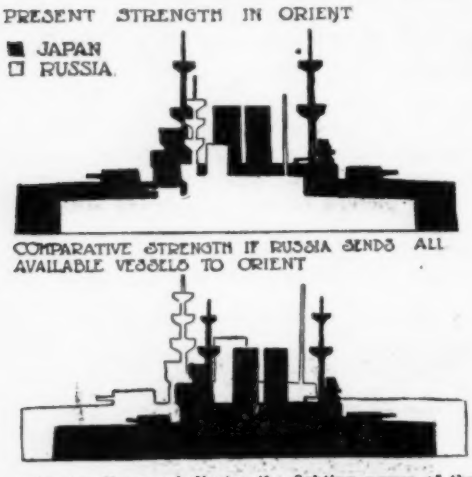
Gertrude Blair, writer on decorative art, says: "Instead of attempting to fill in a grate with plants, use one, two or three sections of the screen. This screen is made by a florist's wireworker. The first section is left uncovered to show its construction. The second is of fabric drapery, with tracery of wood ferns. The third section is covered with green burlap, on which is a design of goldenrod and asters. Sheet moss also makes a good covering. The wire frame and feet of the screen are bronzed. Out on the hearth in front of the screen is where the plants should be grouped, if used at all so far below the eye line."

The Florists' Review says: "Smilax, as it is cut in solid strings, is too heavy for any decorative effect, except for draping large rooms with high ceilings. The strings should be separated to make it soft and light and graceful. The string, as it hangs separated, all except a knot, makes a pretty design unit for the corner of a table, a mirror, or picture frame. The heavy string so prepared will fit into screen frame quite naturally. The addition of another small string will complete the light tracery of the design. Three or four more strings similarly treated may be required in some work."

HEAT EMISSION OF RADIUM.

In a paper recently communicated to the French Physical Society, M. Curie gives further data as to heat emission of radium. The mass of radium was inserted in liquid air and the heat emitted served to evaporate the liquid. The rate of heat emission proved independent of the temperature for the range between the ordinary laboratory temperature and that of boiling air. When immersed in liquid hydrogen, however, the boiling point of which is but a few degrees above absolute zero, it was found that, unlike ordinary chemical reactions which are retarded by low temperatures, the rate of heat emission by radium was apparently actually increased.

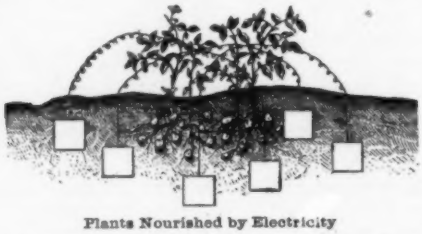
SHOULD RUSSIA FIGHT JAPAN.



The top diagram indicates the fighting power of the Japanese and Russian fleets which would meet in the event of a war breaking out between the two countries within twenty days. In this the whole Japanese navy has been used against that part of the Russian fleet which could be used in the orient without leaving Russia defenseless in the Baltic and Mediterranean. In the lower diagram Russia's Asiatic, Baltic and Mediterranean fleets are combined and compared with the Japanese navy. Russia's big Black sea fleet, which it is believed would not be allowed to pass the Dardanelles, does not figure in the comparisons.

ELECTRICITY FOR POTTED PLANTS.

A French scientist declares that the growth of potted plants may be greatly stimulated by inducing a very gentle current of electricity through the roots. This



Plants Nourished by Electricity

is accomplished by buried plates of copper and zinc on either side of the plant and connecting the plates with wires. The Western Electrician says: A very pretty and educational test may be made at a trifling expense, in the parlor or conservatory, by selecting two plants of the same kind, as nearly alike as possible in every way. A piece of thin copper a couple of inches square, and a similar piece of sheet zinc connected by a piece of copper wire a few inches in length are all that is required. Bury these two pieces of metal on either side of the roots, leaving the wire in the air. The chemical action in the soil will generate a feeble but constant current between these, which in its route will pass through and around the roots and nourish them.

SOCIETY FIRE GIRLS SAVE LIFE AND PROPERTY.

The Girl Fire Brigade of Santa Rosa, Cal., had a chance to show its prowess a few days ago and in truth it demeaned itself right nobly. The fair formed fire fighters were at a social party near by when fire broke out in the home of the Hon. J. T. Campbell. Still wearing their evening dresses, they rushed to the conflagration under the direction of their leader, Miss Bess Riley, daughter of the millionaire cattle king. With water gushing down upon their pretty gowns they carried a man out of the burning building and brought out armsful of costly bric-a-brac. Captain Bess Riley, though soaked to the skin and covered with black by the falling ashes kept bravely at work and her company worked with splendid discipline under her able commands. The building was gutted, but the energy displayed by the young women saved one life and hundreds of dollars worth of costly curios.

WINE WORTH $2,000,000 A BOTTLE.

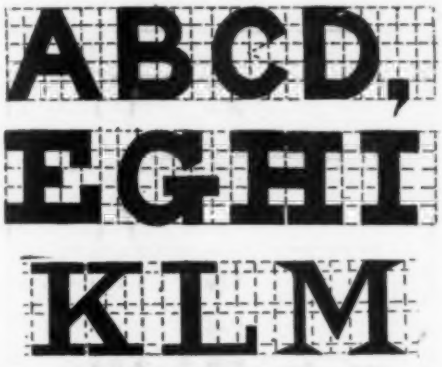
Wine supplied Pope Leo during his last days was the finest ever drank by mortal man. It came from the famous cellars of the Hotel de Ville at Bremen, which has some dozen cases of holy wine that have been preserved for more than 250 years. They are almost priceless. If the cost of maintaining the cellar, payment of rent, interest upon original value of the wine, and other incidental charges are considered, a bottle of this wine has cost $2,000,000; each glassful $274,000 and a single drop could not have been sold under $200.

A law has been passed requiring wide tires on all traffic vehicles in Chicago. The tires must be of one inch width for every 2,000 pounds of weight. The object of the law is to protect the street pavements. It will cost the teaming interests $1,500,000 to equip their wagons with the new tires. The law, it is estimated, will save the city $1,000,000 annually in filling of ruts and holes in pavements.

SHOP NOTES

HOW TO MAKE BLOCK LETTERS.

Beginners who desire to master the art of making block letters will find the following suggestions of great assistance. Draw six horizontal lines forming five spaces, each of exactly the same width. Then divide



these with vertical lines, says the Draftsman, forming small square blocks of equal size. Then practice on the plain letters as shown in A, B, C, D. The same series of square blocks will answer for the style shown in E, G, H, I. For letters K, L, M, N, etc., lay out the vertical guide lines same as before, but run the horizontal lines as shown in the cut. These consist of two parallel lines at top and bottom and one pair across the middle.

CIRCULATING HOT WATER AT LOW PRESSURE.

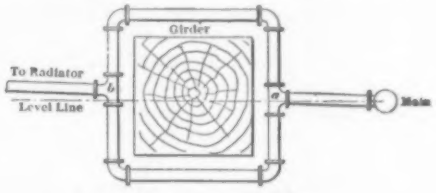
A florist who was greatly troubled by freezing of the hot-water pipes which heat his greenhouse cured the trouble as related in the Florists' Review. He used a pump to circulate the hot water. This pump requires 10 pounds steam pressure to work. In the fall or spring the pressure occasionally went below 10 pounds in the night, the pump would stop and the house get frosted. The trouble was cured by reducing the water plungers one-half, which doubled the power of the pump and enabled it to work on as low as three pounds' pressure. The circulation was all that was required for fall and spring temperatures, and the water returned hot.

SUGAR AS A WOOD FILLER.

Filling the pores with sugar has somewhat surprising effects upon wood. The process, as devised by W. Powell of Liverpool, consists of immersing the wood in heated sugar solution for some hours, the time varying with the wood, and then driving off all moisture in an oven. No previous seasoning is necessary. The spongy fibre is converted into a compact ligneous substance and it acquires greatly increased durability and strength, with resistance to changes of temperature and moisture and even fire. A special advantage is that the softer and cheaper—and even defective—woods can be made to serve many purposes in place of expensive hardwoods. The sugar does not dissolve out, and it does not promote fermentation and the growth of destructive organisms, but it produces some remarkable chemical or physical transformation in a manner not yet understood.

PIPING AROUND A GIRDER.

The cut shows how to run a one-pipe system of hot water heating around a girder without having a noisy pipe. The Metal Worker says: As will be seen from the accompanying sketch, the branch from the main enters the tee a close to the girder. The pipe is then made to form a loop en-



Piping Around Girder

circling the girder, where the two branches come together again at the tee b. This tee is, of course, placed slightly higher than the branch tee a. The condensation will then fall back to the tee b and completely fill the loop. The overflow passes out through the tee a and back to the main, and from there directly to the heater, giving a clear main without impairing its heating qualities in the least.

WASHING RUBBER TIRES.

Michelin, the French maker of automobile rubber tires, states that while moisture is harmful to the tires, and weakens them, it is better to wash the tires than to allow mud to slowly dry.

PRESERVING COPPER TRIMMINGS.

For preserving the color of copper trimmings, such as cornices and leaders, there is probably no better application than to paint with boiled linseed oil, to which may be added a small amount of Venetian red to give it a color tone, but not enough for an ordinary paint. For coloring the copper only to a dark brown, says the Metal Worker, a solution of one ounce of sulphate of copper, one ounce hypophosphate of soda, two drams of muriatic acid to one pint of water, or larger quantities in proportion, may be used to wash the copper surface once or twice, when the color may be preserved by a boiled linseed oil coat rubbed or brushed on.

TO STRENGTHEN OLD BUGGIES.

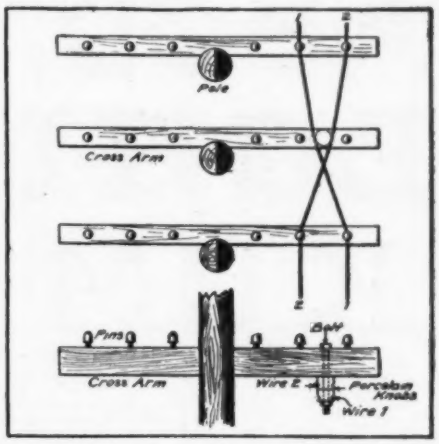
I suppose all parts of the country are filled with a cheap grade of buggies which, after being used a year, will come loose at the corners, the side panels split and spring down below the bottom of the bed, says a writer in the American Blacksmith. Take a piece of two-inch band iron, from six to ten inches long, drill a hole for first bolt in loop, and insert between the bottom of the bed and the loop, so it will come all but flush with outside of panel. Tighten up the bolt. This will draw the panel up to place and will always have something to hold it there. Put a screw in the back end of the iron to keep it straight.

HOW TO MEASURE THE HEIGHT OF INTERIORS.

A simple method of measuring heights in the interior of churches and other buildings consists in attaching a fine silk or linen thread to one of the small balloons which are used for toys and sending it up. The length of the thread is then easily measured, says Self Education for Mechanics. Some have suggested the use of a tape line or a graduated string, but the ordinary toy balloon would not carry up many feet of such a heavy article. The same method may also be used in measuring the height of cavern roofs.

METHOD OF TRANSPOSING WIRES WITH KNOBS.

When compelled by circumstances to use porcelain knobs on the underside of a crossarm on which to support wires and it is desired to transpose, the method illustrated will be found to work well, says the American Telephone Journal. The writer has



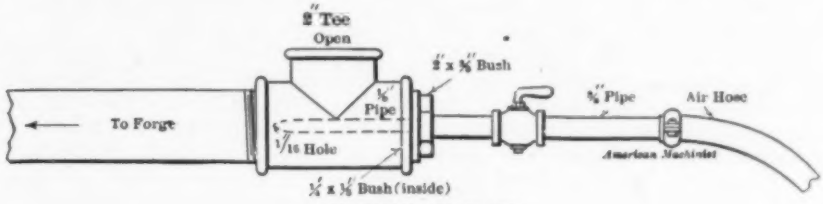
found a 5-16 inch x 8 inch bolt and No. 4 porcelain knobs satisfactory. In putting the arrangement in place, bore a hole for the bolt through the arm, put in the bolt and then put on the two knobs and washer and tighten up the nut.

HIGH-SPEED TOOL STEEL.

That there are several sides to the question of high-speed tool steel was clearly indicated in the discussion of Mr Suplee's paper before the Institute of Mechanical Engineers at Leeds, and there was by no means unanimity of opinion as to the possible advantages that could be gained by its use, says Mechanical Engineer, London. Attempts to force the pace of an ordinary lathe is liable to cause the work to be polygonal instead of circular. One speaker said he had tried reducing a shaft from 4 ins. to 2½ ins. in diameter at one cut, but found this possible only near the fixed head, the springing of the shaft preventing it 6 inches or so from the end, but with four cutting tools at once the job could easily be done at a cutting speed of 50 feet a minute.

HOW TO MAKE A PORTABLE AIR-BLAST.

In plants doing work of an engineering character it is often necessary to have a good hot fire in places remote from the fan-blast system, says the American Machinist. Structural steel works, boiler shops, etc., need this for heating rivets, special flanging jobs, fitting crow-feet braces, etc.; machine and blacksmith shops often need it in the exigencies that arise, and in a hundred different ways the need of it is realized in such establishments.



A PORTABLE AIR BLAST.

The necessary blast can be obtained in any place where you can take a light compressed-air hose, by the simple arrangement of standard pipe fittings shown in the accompanying sketch. The amount of air used is trifling, as the volume is supplied by the outside air which rushes in at the open side of the tee. The sizes shown on the sketch are used on rivet forges and give ample blast.

HARDENING AND TEMPERING STEEL.

To one gallon of common fish or whale oil, take one pound each of beeswax and resin. Put into a kettle and heat till it comes to a boiling point, stirring it once in a while. When thoroughly mixed it is ready for use.

To harden in this solution, heat the steel till the scale rises a little, then immerse in the oil. When cool, heat over a clean fire till cherry red in the dark, says the American Blacksmith.

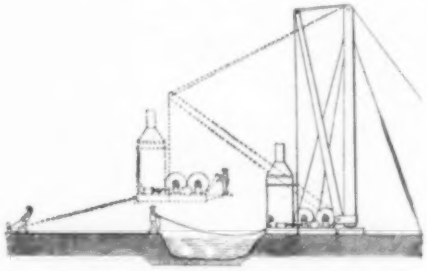
The foregoing, with a little practice, is recommended as one of the best, if not the best, compositions for hardening steel tools for use in cutting iron or wood, or even steel. Care must be taken as to the amount of resin in the oil, as resin hardens the steel, whereas beeswax and tallow toughen it. If a person prefer to temper in daylight, clean the steel or tool, polish it, and draw to a deep straw color, if for cutting iron or steel, and purple if for wood-cutting tools, such as plane irons, cutters, etc. With this composition, 'tis said, a better temper can be had for wood-cutting tools than with any other composition.

MAKING AN ENGINE LIFT ITSELF.

A most curious and unusual case is reported in the Engineer, of how a hoisting engine was made to lift itself across a creek. The engine was used for hoisting and laying stone on the sides of the creek. When it became necessary to have the engine on the other side there was no bridge near or anything to make one of, so it was determined to hoist it over on the same rigging it was on.

This was done in the following manner: The rope which controlled the boom was made fast to the rear drum when the boom was as nearly vertical beside the mast as it could be placed; the hoisting rope was fastened on a chain just back of the rear drum so as to balance the engine. The engine was started and, as it began to rise, the boom began to lower until they almost met, when the engine was swung over the creek and lowered by letting out on both ropes.

When moving any engine in this way, great care must be taken that the engine does not strike the mast after leaving the ground, for if it did the results would be disastrous. The figure gives the position of

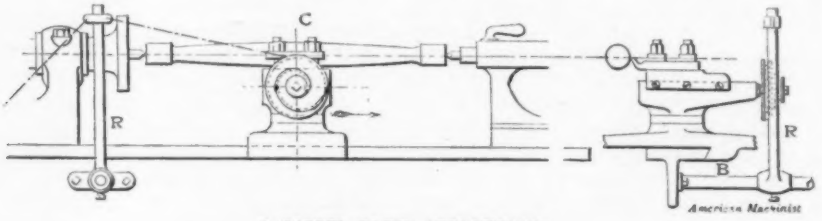


Moving the Hoisting Engine

the engine before starting, which was 12 feet away from the mat, and the position of swinging across the creek which was 30 feet, also the position of the guide ropes used for controlling the engine while being moved.

A "BARREL" TAPER ATTACHMENT.

The handy attachment here described can be attached to any existing lathe having an ordinary compound slide rest for shaping large connecting rods, etc., says the American Machinist. These tapers, not being straight lines, are sometimes known as "barrel tapers," and as the rods have to be a good finish they require to be a first-class job, without the ridges generally seen on hand work. A vertical rod R is fixed on a bar B, the latter terminating in a foot fixed to the side of the lathe bed. To the rod R a length of weight chain is attached by a collar and set screw, and to prevent any



A BARREL TAPER ATTACHMENT.

tendency to drag over the chain is carried beyond the upright to the left and the end fastened to the lathe bed. To produce the convex outline on the rod a cast-iron scroll is made from 8 inches to 12 inches diameter, of four or five convolutions, to fit the end of the cross screw, the cut is taken from the center C, and by traversing the carriage toward the tailstock the chain gradually unwinds, giving an increasing traverse to the top slide and producing the required contour automatically.

HOW TO BECOME A MILLIONAIRE IN A MONTh.

It seems easy. Just save a cent today, two cents tomorrow, four cents the third day, and continue through the month doubling each day the savings of the preceding day. At the month's end you would be a multi-millionaire. Try it on paper; any other way is impractical, of course, and the way most people get rich is on paper.

TO HARDEN FILES—WELDING TRICK.

The American Blacksmith says: To harden files dip the file in red-hot lead, handle up. This gives a uniform heat and prevents warping. Run the file endwise back and forth in a box of salt water. Set the file in a vise and straighten it while still warm. Apply water to the part straightened until cold, and you have a good file.

A welding trick is given by a correspondent of the same paper, as follows: I know that a great many smiths—and good ones, too—look upon steel welding with something little short of fear. The way I go about it is first to be sure my fire is perfectly clean, and then to take my heats very carefully, getting as good and even heat as possible without overheating the steel. After proceeding in this way, and using borax only for a flux, if one does not succeed, let him try mixing some fine borings with the borax and covering the weld with this. I find that borax and fine steel borings from my drill are a splendid compound for steel welding.

PETROL ENGINES ON AUTOMOBILES.

"Genie Civil," a French publication, says: "In a recent paper on the subject of petrol engines on automobiles, M. Guillardet gave about 70 pounds per square inch as the best compression, and from 11½ feet to 14¾ feet per second as the best piston speed. M. Pozzy in a paper on springs for the vehicles, recommended for the front axles of light vehicles, springs deflecting from .43 inch to .49 inch per hundredweight whilst the back springs should deflect from .49 inch to .59 inch under the same load. For heavy vehicles the front springs should deflect .39 inch to .43 inch per hundredweight, and the back ones .45 inch to .55 inch. For motor freight wagons he recommended springs deflecting from .19 inch to .24 inch per hundredweight at both front and back."

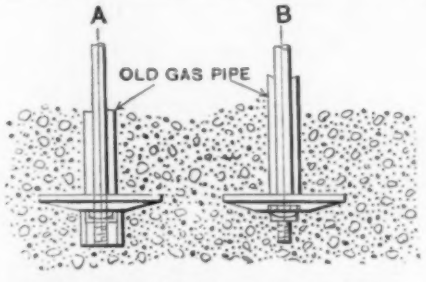
CONCRETE FOUNDATIONS FOR MACHINERY.

An interesting article appears in the August number of Machinery on making concrete foundations for machinery. In selecting the sand, on which much of success depends, use a bank or pit whose grains are angular or sharp. If mixed with clay or loam the sand must be washed before using. The gravel used in this work is usually found with the sand. In good gravel the stones are hard, and irregular in shape and size. Broken stone makes better concrete than gravel but is more expensive. The stone should be graded from ¼ to 1 inch in diameter.

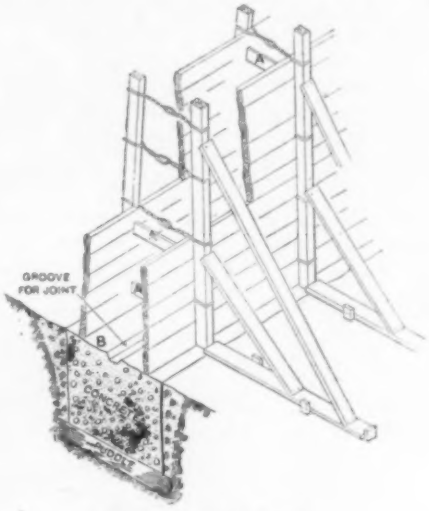
The cement used should be of good quality; as a rule the heavier are the best: it should weigh about 375 pounds to the barrel for Portland, 300 for Rosendale and 265 for Louisville. The more finely ground the cement the better for this work. Natural cement should not take its first set in less than 10 minutes, nor require more than six hours for final set.

The term "first set" may be determined by a pat of neat cement supporting without indentation a ¼-pound weight on a wire 1-12 inch in diameter; final set by the pat supporting a 1-pound weight on a wire 1-24 inch in diameter. Portland cement should not take its first set in less than thirty minutes and should take its final set in not more than 10 hours.

To sample a lot of cement in barrels, take an auger and drill into the barrel well toward the center. Enough should be taken out to make a pat some 3 inches in diameter and ½ inch thick at the center, tapering to ⅛ inch at the edges. The cement should be mixed with just enough water to form a dough and should be worked for several minutes, then formed into the pat. A piece of glass or an old plate is the proper thing to make the pat on. This pat should be watched to determine the first set and should then be covered with a damp cloth for about 24 hours. At the end of that time it should be placed in water (plate and all) and kept there for several days or even three or four weeks. It should show no sign of disintegration along the thin edges and no signs of distortion, or expansion cracks. Cement showing lumps should be looked upon with suspicion and tested thoroughly. Mix thoroughly; better have too much water than too little.



Anchor Bolts and Plates—Cement Foundation



Form for Concrete Work

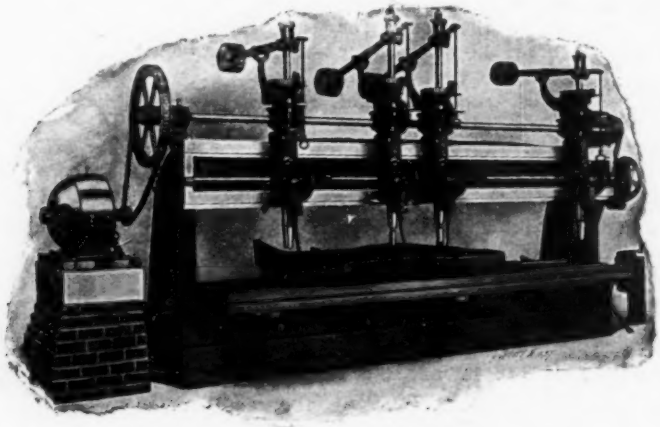
If possible, foundations should rest on hard pan, gravel, or hard clay. Made ground should be shoveled out for a depth of at least 12 inches below the bottom of the foundation and rammed as hard as possible. The 12 inches should then be filled with clay puddle, well rammed in place. Of course the forms must be strong, tight and smooth on the inside. A good form is shown in the cut. It will be noted that the wall is braced in three places, besides being wired. The wire is about No. 12 iron wire. The braces AA are loose, or only tacked in place, and are removed as the wall is built up. Do not nail the sheeting too securely to the studding. Any carpenter can put these forms up and the cheap, unskilled men that wheel the concrete may be employed to assist in the bracing and sheeting. Different methods of bracing the forms will readily suggest themselves to the mechanic in charge, to conform to the local conditions. The cut shows the wall with a footing extending several inches outside it. If the ground is

firm, no sheeting is required for this footing, as the concrete is merely thrown into a trench and rammed. In any case the wall is brought up as far as the point B and allowed to set a few hours before the forms for the wall proper are started.

The second cut shows the placing of the anchor bolts and plates. For important work such as engines and rolling mills, the foundations should be arranged with tunnels and pockets so that the bolts can be pushed down through the holes and the nuts and washers put on from below.

NEW MOTOR DRIVE AT COLLINWOOD.

An interesting motor drive has recently been installed in the new locomotive and car shops of the Lake Shore & Michigan Southern railroad at Collinwood, O., probably the most modern and thorough complete railroad shops in the world. The motor drive is shown in the illustration. It is a four-spindle Niles mud-ring drill driven by a 7½-horsepower multiple voltage Crocker-Wheeler motor. The motor is mounted on a stone-capped masonry pedestal at the end of the tool and is connected to the shaft by a Reynold silent chain. Each of the spindles of this tool has an independent drive and independent feed clutches and may be adjusted along the cross rail by a rack and pinion.



Four-Spindle Drill Driven By Electric Motor

Operations in frog skin-grafting continue. An operation performed in the Massachusetts Homeopathic Hospital recently on a woman's eye, where the flesh is most sensitive, was wholly successful.

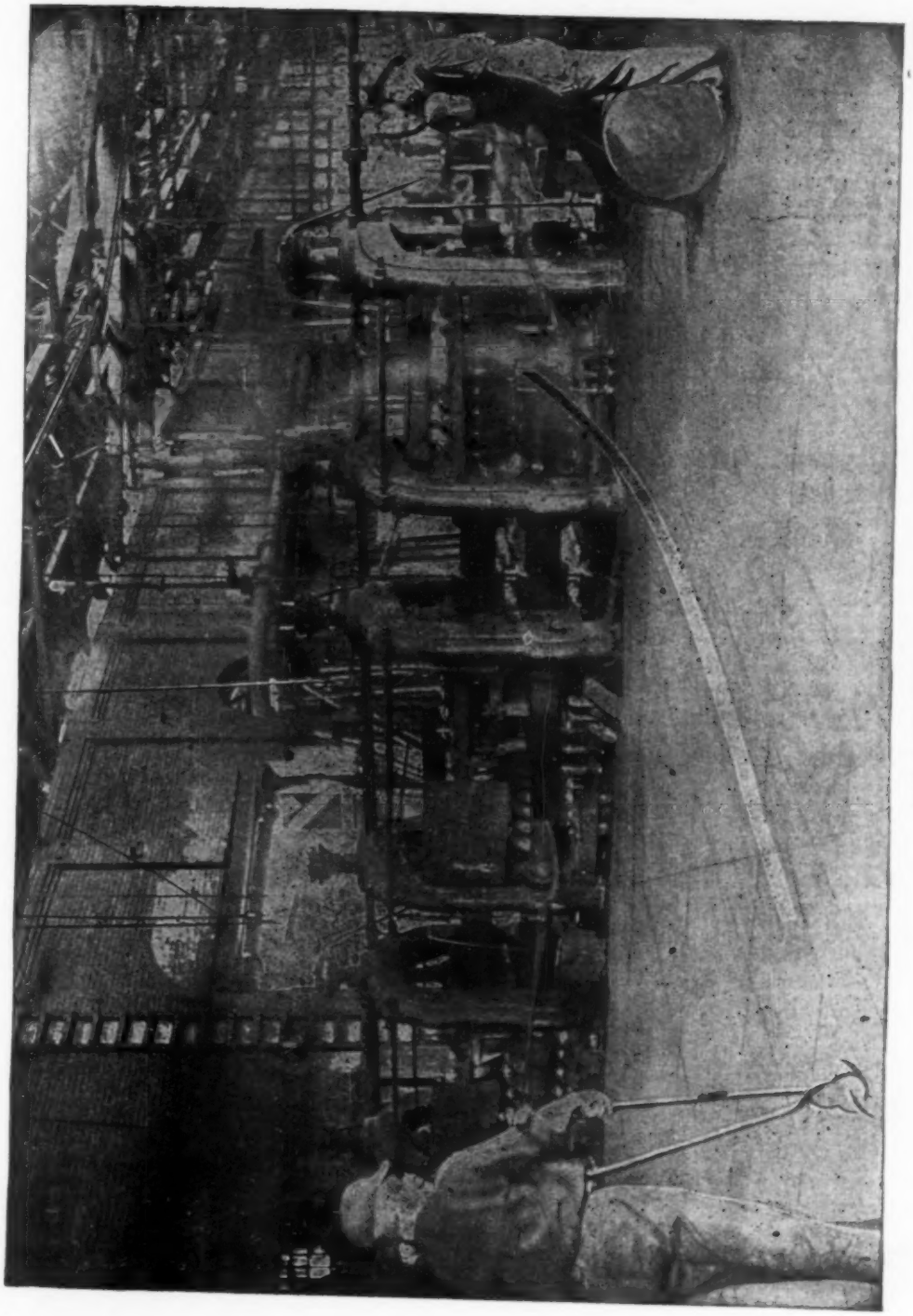
HOW MERCHANT IRON IS MADE.

Description of the Process from the Placing of the Scrap Iron in the Furnace to Loading on the Car.

Making merchant iron is one of the most important industries in America, the country famed for its production and consumption of iron and steel. Yet there are few outside of the foundry who have an idea of the great amount of labor and skill employed in this work.

Up in Pueblo, Colo., there is a superintendent of mills, J. B. Monahan by name, who, besides knowing how to make nearly every product of the foundry, has the happy faculty of telling understandingly how it is done. Mr. Monahan is in the service of the Minnequa works of the Colorado Fuel and Iron Company. Here is his description of the methods there employed:

The process of making merchant iron is the same in all mills, differing only in the size of the piles and weight of the finished bars. In the first place wrought iron scrap is piled by hand into a compact mass called a fagot and bound together with wire and pieces of bar. A number of these fagots are placed in the furnace and heated to a welding heat. They are then carried to the rolls by long tongs, suspended from overhead and are passed through several grooves in the rolls, each groove smaller than the last, until reduced to the proper size. The enormous pressure brought to bear on the fagot during the first few passes through the rolls,



30-Inch Mill for Rolling Heavy Iron Bars

called "roughing passes," welds all the particles of iron firmly together and makes a billet or a fagot bar. The difference between a billet and a fagot bar is one of form only, a billet being square in section, while a fagot bar is flat. A very thick bar is called a "slab" and is used for rerolling into a very thin finished bar.

After the fagots have been rolled into billets they are simply sheared to proper length, reheated and rolled into finished iron by the same process that made them billets. If heavier iron is to be made, fagot bar is used. The bar is sheared to proper length and the pieces are laid one upon another until the pile is just about as high as it is wide. These piles are then placed in a furnace, heated again to a welding heat, and the same process as before makes finished iron. The second rolling lengthens the grain of the iron, removes all scabs and other defects, and makes a smooth, marketable piece of iron.

Steel requires but one working in the merchant department, as it comes from the steel department in the form of blooms, billets and slabs. It is treated the same as iron is after the first working.

When the iron or steel has gone through the rolls for the last time, and is reduced to the proper size and shape, it must be cut to length. The smaller sizes are sheared by powerful, electric, alligator shears, and the larger sizes are sawed, while red-hot, with a saw driven at high speed by an electric motor. Owing to the fact that iron contracts greatly while cooling, it is impossible to cut it to exact lengths while hot; therefore, if exact lengths are desired, the bar is allowed to become cold and is then cut to exact lengths on another machine called a "cold saw."

The bar is now a finished product and is ready for the warehouse, where it is weighed, inspected for possible flaws and put into stock or loaded directly into freight cars.

The 20-inch mill, shown in the illustration, is used for rolling heavy bar and for making fagot bar, billets and slabs to be worked over on this and other mills. It has two three-door gas furnaces, each having a capacity of 15,000 pounds of steel or 9,000 pounds of iron to a heat. Twelve heats constitute a turn on this mill, and two turns are worked in 24 hours.

OUR FOREMAN CAME AND WENT.

Yes, I remember well the day when our last foreman came,
'Twas just to brace us up a bit and show us that the game
We had been playing up to then was not the real thing
To turn the work out fast enough and in the shekels bring.

He soon got walking round the shop, his confidence soon grew;
At lunch time it was "Bill" and "Jack," ere six he begged a chew.
And call him by his Christian name? "Most certainly!" said he,
Where'er he'd been he always liked most sociable to be.

Oh, yes, he'd been about a bit; and then, with manner large,
He told the stories of the shops in which he'd taken charge.
He'd had the millers down at Smith's, and up at Jackson's shop
He'd run the automatics there, where he'd just made them hop.

And he had been a draftsman, too, but took no interest;
That kind of work was all too slow. No! he liked press work best.
At Firem's on one piece he'd saved them operations three,
And when he left, their sorrow it was pitiful to see.

He liked close work; he'd have it, too, he said, with half a smile.
A thousandth was an inch to him; an inch was half a mile.
And when his kit it came along he'd give them drawings, too;
But for the present, why, he guessed freehand would have to do.

He hung on well until the time when jobs began to change,
And a set of piercing and bending dies, which he'd got to arrange,
Came through the shop, and with them, as the days they onward flew,
Disaster grave came to him, and he found his Waterloo.

The pieces on the scrap pile laughed, with most unholy glee,
At forty thousand comrades come to share their misery.
He left us with a sorrowing heart another job to take,
And desolation, sour and grim, it follows in his wake.

—American Machinist.

Swift patrol boats are to be manned and armed by Canada and placed at different points in the great lakes to prevent American fishermen from fishing in Canadian waters. The boats will be armed with rifles and seven-pounders.

REMOVING WATER FROM GASOLINE.

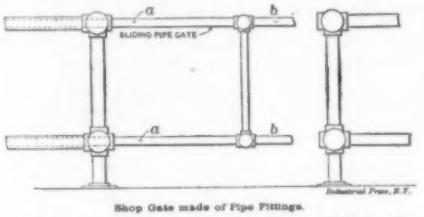
Water in gasoline causes great annoyance to operators of automobiles and launches. Gas Power tells how to remove the water:

"It is known that fine mesh wire gauze will not let water pass, while it allows the gasoline to flow through it freely. If, then, the gasoline is caused to flow upward through a wire gauze sieve, the water will separate from it and collect in the bottom of the vessel in which the sieve is located, from which it may be drawn by means of a cock.

"The idea of such a filter for separating the water from gasoline is not at all new, several devices of this kind being actually to be had on the market, but the frequent complaint about water mixed with gasoline seems to indicate that these devices are not as well known to users as they might be."

SLIDING GATE FOR SHOPS.

A convenient sliding gate can easily be made with ordinary pipe and fittings, says Machinery. The gate of course is made of a smaller size of pipe than the railing so that

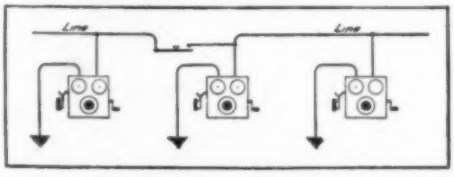


Shop Gate made of Pipe Fittings.

the ends a a can slide freely within them. The ends b b also slide into the opposite pipe ends of the opening when the gate is closed.

A SCHEME FOR A BRIDGING LINE.

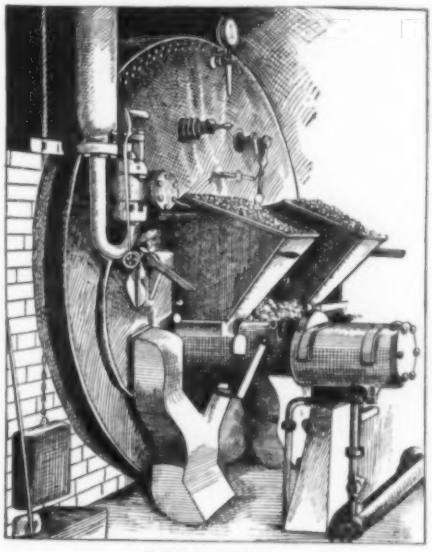
The figure indicates the way in which the writer utilized a wire which otherwise might have gone to waste. Formerly a



series telephone line was in use and two wires were run 500 yards from the road to the house in which the instrument had been placed. Bridging instruments are now being used. There are 12 of them and the line is 40 miles long, says the American Telephone Journal. When the change was made instead of one of the wires being taken down a switch was installed as shown. When it is wished to ring toward town the button is pressed and the full strength of the current goes that way, making a stronger ring.

NEW AUTOMATIC STOKER.

A new automatic stoker has appeared in England, known as the Erith, which operates without the use of grate bars. A



English Stoker

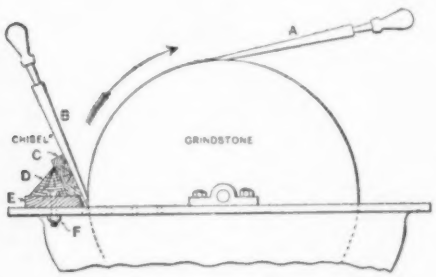
fresh charge of fuel is thrust into the furnace, automatically, at frequent intervals. It is said to burn the coal without producing any smoke.

"Something Electrical for Everybody" is the title of a booklet containing 84 pages and over 300 illustrations, telling all about the hundreds of electrical specialties for home and office use. The chapter on burglar and fire alarms for the home is specially interesting. The book will be sent free to our readers, who write the Manhattan Electrical Supply Co, 186 Fifth Ave., Chicago, and mention this magazine.

A doctor in Brooklyn, who is a famous marksman, has invented shooting spectacles for sportsmen with failing eyesight.

JIG FOR GRINDING A CHISEL.

Patternmakers and wood-workers who grind chisels, plane irons, etc., in the old way by holding them on the stone as shown at A will find the little jig for holding them as at B to be a great convenience. The two pieces C and D are screwed or nailed together and braced by the bracket E. Then the piece C is beveled to give the proper angle to the edge of the tool. The fixture is fastened to each side of the grindstone



Grinding Chisel Jig

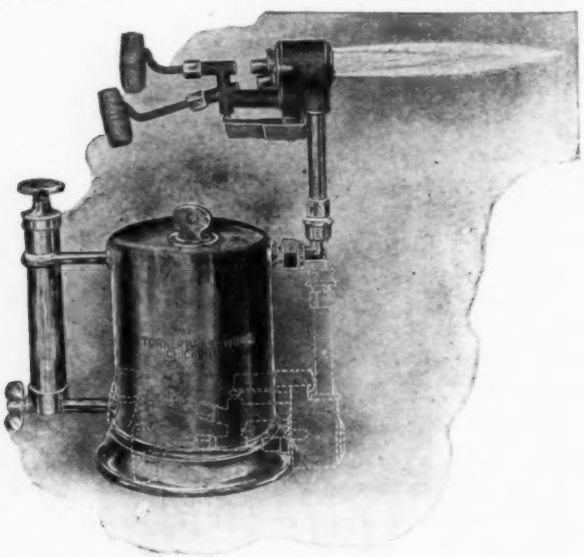
through by the bolts F, and a series of bolt holes is drilled through each flange of the trough so that the jig may be moved in as the wheel is worn down. With this attachment says Machinery the writer has ground trimming knives as accurately as could have been done on a special emery grinder.

HINTS TO INVENTORS.

Who will win the fortune awaiting the inventor that succeeds in stopping the noise made by cars on elevated roads. Millions of dollars in damages suits are already pending where damage is claimed on account of the noise. In Berlin all the trials made by the government were failures. Layers of felt were placed between the ties and rails; hollow iron girders filled with loose sand were substituted for the wooden ties. The rails were laid on sheets of lead. Wood was placed between the car wheel and its tire. If you want to succeed try some other plan than these.

SAWS WITH DIAMOND TEETH.

The most valuable saws in the world are in Pennsylvania, in the factories where various articles are manufactured of slate. In one of these factories there are 30 horizontal saws, twelve feet in length, each of which is furnished with 75 cutting diamonds, each saw being worth $5,000. The huge horizontal saw with its scores of diamonds is called into play when large blocks of slate are to be cut for other purposes than shingles; it is lowered upon one of the blocks of slate by a ratchet at the rate of a quarter of an inch a minute. The saw would cut through iron and steel at the same rate. The workmen play a stream of water upon the slate to keep it cool and wash the dust from the cut.



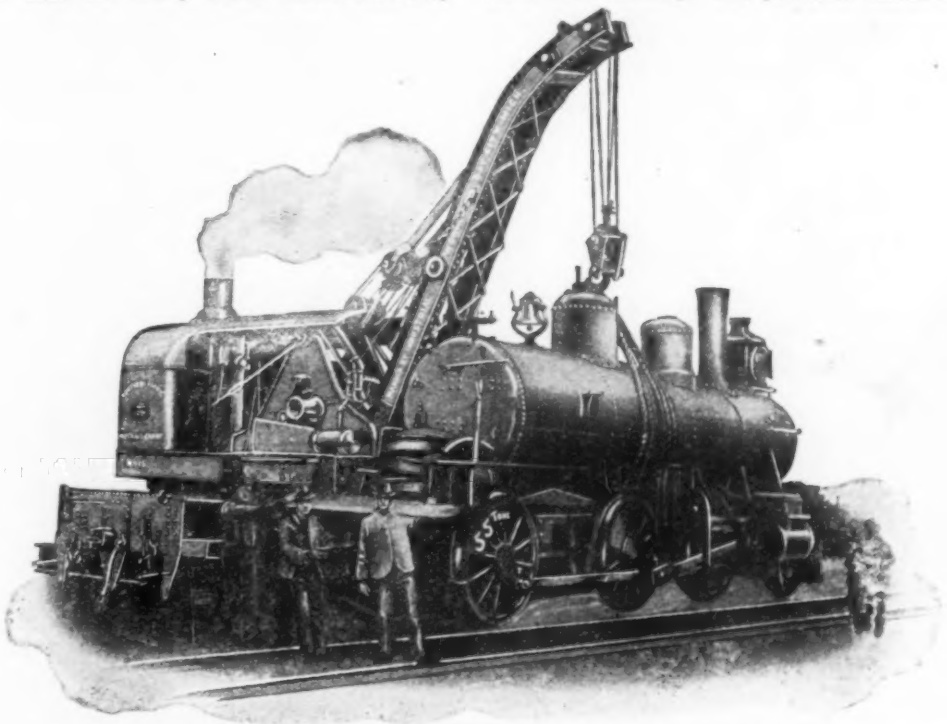
NEW GASOLINE TORCH.

New gasoline torch with a double jet burner is illustrated herewith, and will interest rubber workers, electricians and mechanics in general. The torch, which has a double jet burner producing great heat, is made by the Turner Brass Works, Chicago. The cut shows the burner in an upright position and the dotted lines at the base of the reservoir indicate the extreme points at which the burner can be placed at either side. A very high efficiency is secured through the improved mixer, which allows of an independent control of the air and gas by means of separate valves.

Machines That Pick Up Giant Locomotives

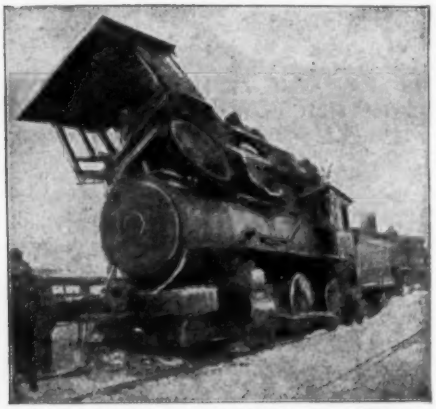
Monster Cranes Lift the Engines Bodily from Wrecks and Perform Duties Indispensable to Modern American Civilization

Monster machines that run on railway tracks and pick up the great present-day locomotives when they have been wrecked are among the most wonderful products of the twentieth century mechanic's skill. Although locomotives have been doubled in weight and capacity of recent years in order to haul the heavy trains made necessary by America's rapidly growing commerce, none of them is so heavy that these powerful machines cannot lift it bodily from the wreck. The machines are called wrecking cranes. The new ones of such extraordinary capacity are the outgrowth of the modern giant locomotive, which leading engineers declare has reached the limit of weight. Handling these colossal locomotives after they have been wrecked would be an almost impossible task without such a machine as the wrecking crane. With it, however, the task is simple and easy. All the great trunk lines that employ the new big locomotives are equipped with these cranes. With a competent crew to man them they are kept constantly in readiness for a hurried run to a wreck. They are a late-day auxiliary to the wrecking train. By the time the wrecking crew is called and ready for the scene of disaster the crane crew is in waiting. The powerful machine is coupled to the wrecking car and the run to the wreck begins. Millions of dollars' worth of property and many lives have been saved by the timely arrival of the cranes.



Lifting a Derailed Locomotive to the Track With a 50-Tons Capacity Crane

The 50-ton cranes manufactured by the Industrial works, shown in the illustrations, are the strongest it has been possible to design with the limiting conditions under which they must be constructed for transportation. These limiting features in such a machine are several. Its weight per lineal foot upon the roadbed or bridge over which it must be transferred must not ex-



The Nearest Two Locomotives Ever Came to Passing on the Same Track

ceed the bridge engineer's designs. The clearance dimensions must be no greater than heretofore, for lighter designs and fast running in trains as well as improved features in mechanical construction are modern necessities.

In lifting the modern steel frame car from wrecks the crane also performs an estimable service. The crane's capacity allows it to lift bodily the heaviest cars with their loads. Recently the wrecking crane has been called on to perform service in some remarkable wrecks, as the illustrations will show.

In one wreck when the wrecking outfit arrived one of the locomotives was found astride the other, the top one seeming to have been inclined to run over the switch engine and continue on its way. The foreman of the crane says this is the nearest two locomotives ever came to passing on the same track.

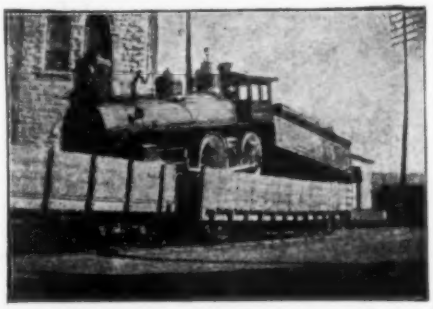
Lifting the Overturned Locomotive

An extremely difficult task the crane was called on to perform is illustrated in the picture showing the demolished and overturned locomotive. This was a bad wreck, but the engine was soon picked up from the debris, placed on a flat car and hauled back to the repair shops.

The frame work of the car supporting the 50-ton crane is more than 24 feet long and 9½ feet wide. It is constructed of 24-inch I-beams weighing 100 pounds per foot, with end sills 34 inches deep by ¾ inch thick, plate journals 6 inches by 10 inches.

The engines operating the crane are double, with cylinders 9 inches in diameter and 12 inches stroke. The boiler has a diameter of 50 inches and is 9 feet high; it is of the submerged flue type and is provided with a magnesia jacket and the best design of trimming for the service.

Flexible wire rope is used for hoisting and there is sufficient length of rope upon the barrel when the lock is detached and a single line used to allow the hoisting hook to reach 75 feet from the crane's jib. To add stability to the car during heavy lifting a system of telescopic outriggers is provided. These outriggers may be thrown out on either side of the car and under them may be placed blocking or portable jacks furnished with the machine. When not in use these outriggers are drawn in and do not interfere with traveling upon the road. Through the appliance provided the radius of the jib may be varied by the engine



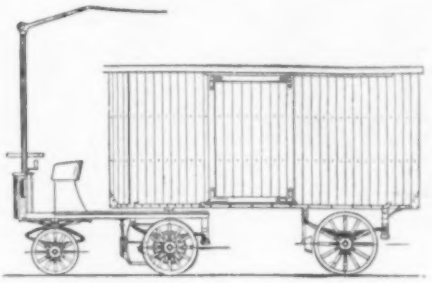
Queer Results of a Rear End Collision—Wrecking Crane Not Necessary

from a maximum of 24 feet 8 inches to a minimum of 16 feet.

The weight of the crane in working order is approximately 77 tons, which weight is distributed over a wheel base of 17 feet 4 inches.

TRACKLESS FREIGHT TROLLEY.

Germany is rapidly coming to use its excellent streets and country highways for trackless trolley cars. The overhead wires



Trackless Trolley Freight Car

are erected in a manner similar to our own electric lines, but instead of going to the enormous expense of putting down tracks, the cars run upon the pavement. The connection to the trolley wire is sufficiently long to permit of turning out for other cars or wagons. The illustration from the Electrical Review, London, shows the latest type of trackless trolley freight car mounted on six wheels. The car carries a load of 1½ tons, with motors of 15 horse power, at a speed of 8 miles an hour.

TO MAKE THE NAVY MORE ATTRACTIVE.

Recreation halls, fitted with gymnasiums, reading and lounging rooms; baseball and football grounds and other means of diversion are proposed by the Bureau of Navigation for all the navy yards and stations where men are recruited, or are kept on duty for any length of time. With these attractions, it is thought, the men will not have a desire to resort to saloons for amusement. Furthermore, it is believed that they will serve to revive interest among those who might consider enlistment in the navy, it now being almost impossible to fill the authorized quota because of the growing apathy for the service among young Americans.

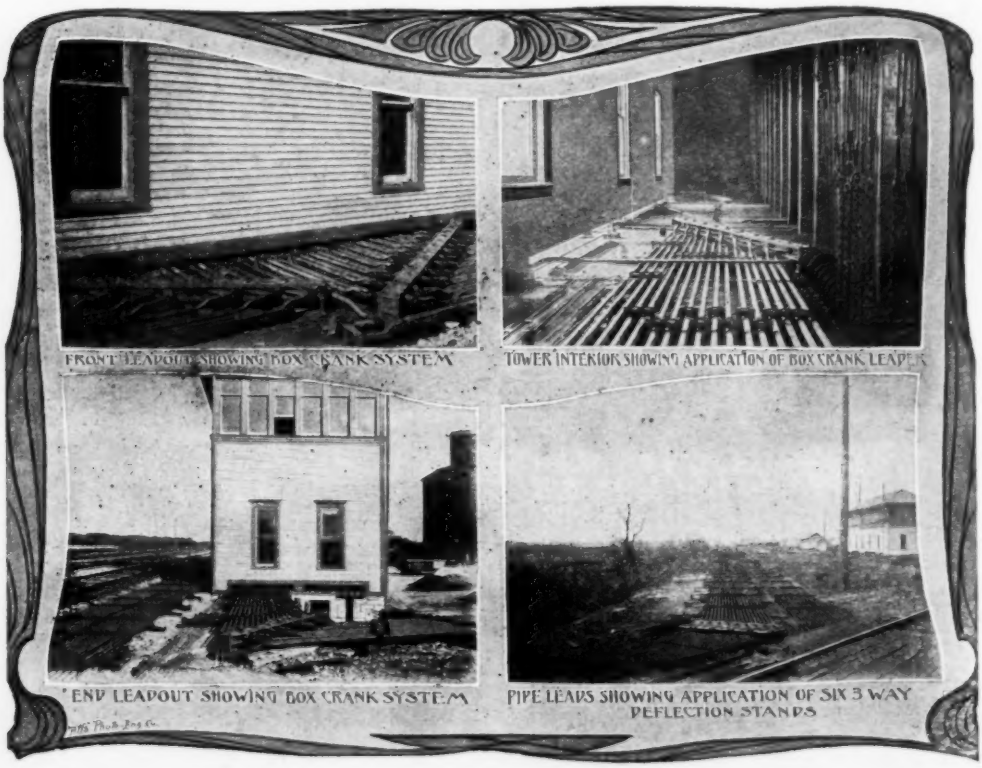
The production of cement in the United States during 1903 will amount to 18,000,000 barrels.

The Erie canal, say competent engineers, must either be enlarged or abandoned.

Modern Signals and Switches

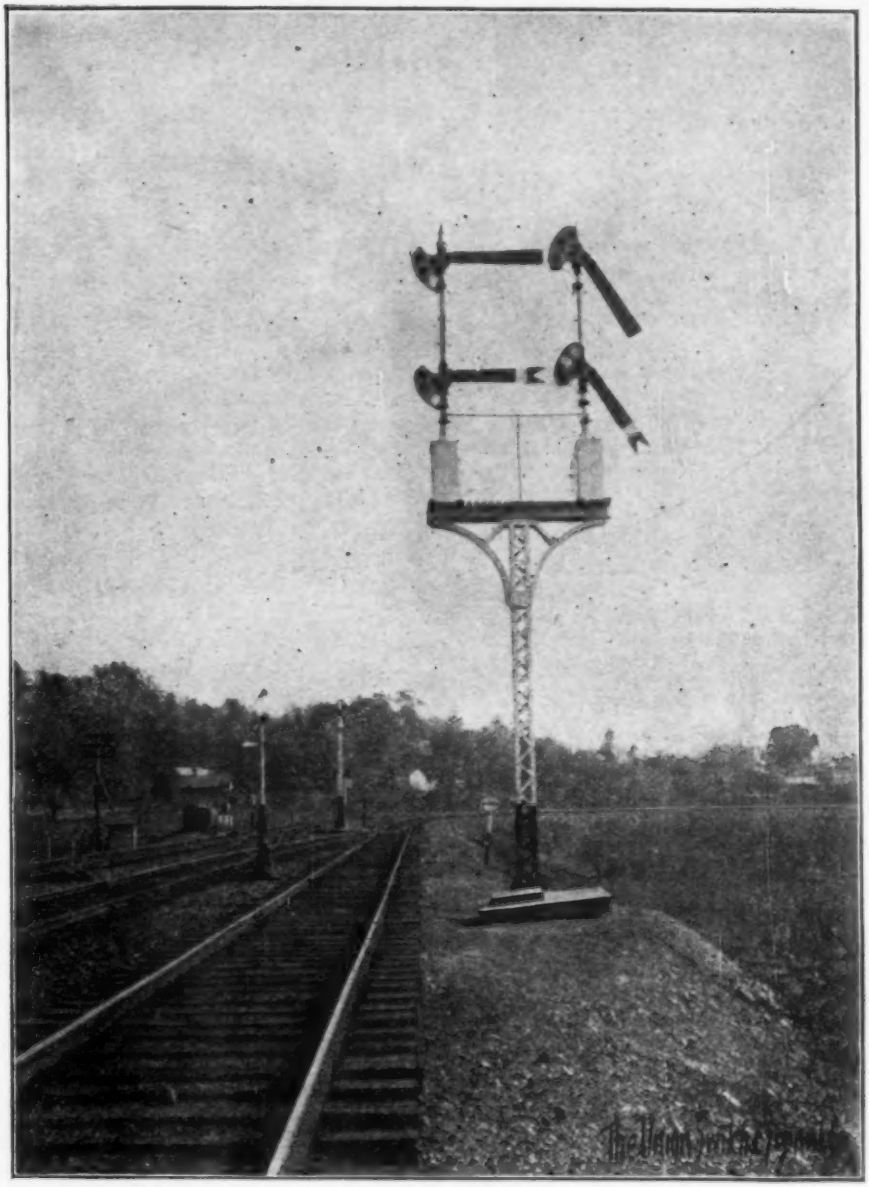
Interlocking Machinery Has Performed Wonderful Changes in Methods of Handling Trains

The advent of the interlocking machine worked a great revolution in the method of handling trains. Greater celerity, safety, reliability and convenience has been the result and when the railroad man now looks into the past he wonders how it were possible to get along with the old style switches and signals. Now great establishments are employed in the manufacture of interlocking machines with the many appliances for making connections between them and the derails, signals, etc., controlled therefrom. The jaws, cranks, rocking shafts, compensators, pipe and wire carriers, chain wheels, etc., together with wood, concrete and iron foundations now are all made special objects of the manufacturer's skill.


FRONT LEADOUT SHOWING BOX CRANK SYSTEM
TOWER INTERIOR SHOWING APPLICATION OF BOX CRANK LEADS
END LEADOUT SHOWING BOX CRANK SYSTEM
PIPE LEADS SHOWING APPLICATION OF SIX 3 WAY DEFLECTION STANDS

The many late improvements result from the disposition of railroads during the last five years to install work of a more permanent and durable character, with a view of reducing the expense of maintenance and operation at a slightly increased cost of installation. This is why the use of wood in the building of bridges and other railway structures has been largely abandoned in favor of more lasting materials, and in signal and interlocking work the best modern practice has decreed that signal posts shall be constructed of iron or steel and that all foundations or supports subject to decay shall be of iron or concrete. As a result several styles of iron and concrete foundations are now being manufactured to meet the modern demands.

Types of solid, adjustable, wide and double jaws, connections and pipe lugs in general use today are of a most substantial character. The "gainstroke" jaws, of recent invention, permit the amount of lost motion to be varied at will, and the clamped pipe lug can be attached to the existing pipe



View Showing Electric Semaphore Bracket Signal and Battery Well

line without cutting or disconnecting the latter. In considering the sizes of jaws it is well to remember that the size of jaws is usually determined by the diameter of the shank.

As showing the rapid progress in the methods of switching and signaling the Union Switch & Signal Co. has made this public announcement: "So many changes and improvements have been made in signaling appliances since our last general catalogue was issued that we find it necessary to almost entirely revise that edition, and in order to place the information before our customers as quickly as possible we have resolved to issue our revised catalogue in sections as rapidly as we can collect the necessary data."

So enormous has been the demand for improved switches and signals that this com-

pany has just built entirely new shops of more than double its former capacity. Other companies are following suit and the switch and signal business is becoming of enormous importance.

The new electric semaphore bracket signal and battery-well is probably one of the most important additions to modern signaling. A cast-iron battery chute of simpler design than formerly has recently made its appearance. In this the large rectangular box head has been replaced by one of more compact and simpler form. The cover of the chute is entirely removable, not being secured to the head by hinges, but by a small lip which projects down from one side of the cover and fits under a flange on the rim of the head, securing the cover thereto so long as the chute remains locked.

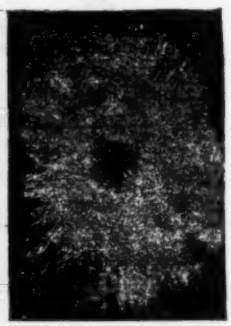
The single and double cast iron battery chutes lately introduced are models of simplicity and durability as compared to old designs. To accommodate the increased size of the new "Universal" style of relay there has been designed a larger type of cast iron relay box capable of containing two of these relays and having its door fastened with a clamp similar to those in use on the Union electric semaphore.

Being both dust and weather proof the new vertical rotary switch circuit controller possesses many advantages. The instrument is especially designed for use in automatic rail-circuit block signaling, where the movement of a switch from the main line is required to hold at or to move to danger the signal or signals governing the block in which the switch is located. Its contacts are formed of heavy bronze strips tipped with platinum and are exempt from the wear and tear that takes place in the contacts of boxes where a vibratory motion is given to them by each car wheel passing over the switch. In this design the vibration is absorbed by the vertical rotary cam substantially constructed for this purpose, and is nominally disengaged from the contact shifter, thus imparting to it no movement, save when the switch is operated. It can be placed in either side of the switch and is suited to switches having a stroke of five inches or less without any modification whatever. Frogs and crossings also display a great deal of mechanical ingenuity in their recent improvements.

New Science of Atoms Revealed By Radium

The astronomy of atoms is the term applied to the new theory of matter being developed through the discovery of radium and kindred substances. The atom, which

Emanation of Radium from a Button



Emanation of Radium from a Coin

has heretofore been regarded as the smallest division of matter, is really composed of a multitude of inconceivably smaller things named electrons. These, it is shown, revolve about each other within the confines of the atom in paths resembling the orbit of the earth and the other planets composing the solar system.

Instead of being packed close, as might be supposed, the revolving electrons in an atom have proportionately as much free space about them as there is between Mars, Jupiter, Saturn and other planets of the solar system. The body of a man, which is composed of innumerable atoms, may thus be likened to the universe. For man's body is composed of a vast number of systems almost infinitely small in comparison with its own dimensions. Furthermore the manner in which the electrons composing the atoms revolve about each other resembles the manner in which the planets, comets, asteroids and meteors of the solar system travel in their concentric orbits, and the principles of celestial mechanics, perfected by Newton, Laplace and other mathematicians, to account for the motions of the heavenly bodies, avail to explain also the movements of the infinitesimal electrons of which atoms consist. But these electrons, while they constitute the atoms of which all material substances are made

up, are not themselves conceived as being a form of matter.

Experiments tend to show that the electrons are purely electric in their nature. However, when combined in the shape of atoms they furnish the basis of what we know as matter. While only radium and cognate substances continually give off particles sufficiently abundant to reveal the fact to us, yet the theory under consideration assumes that all atoms of all substances whatever are slowly tending to dissipate themselves in this manner, and that in the course of infinite time the whole universe will thus be changed in its atomic constitution over and over again through the alternate dissociation of atoms and their reformation in new combinations. Already it has been found possible to calculate the number of electrons contained in various kinds of atoms. Seven hundred were found in an atom of hydrogen, 15,000 in an atom of sodium, and over 100,000 in an atom of mercury. Thus the number of "electric worlds" contained in the miniature solar system represented by an atom of mercury is far greater than that of all the known planets, asteroids and comets in the solar system of which our earth is a part.

Concrete Mixers Employed in Great Works

Cube Type Devices Work Without Aid of Moving Parts--One Kind that is Picked Up by Derrick and Carried Where Desired

The extensive masonry work required in building the great Chicago sanitary and ship canal and the construction of the famous Cleveland breakwater has brought to the front an ingenious concrete mixing machine of the cube type. Mixing concrete, mortar, ore and other materials without the aid of any moving parts, such as paddles, shelves, discs, etc., in the cube where the mixing is done, the device is exceedingly

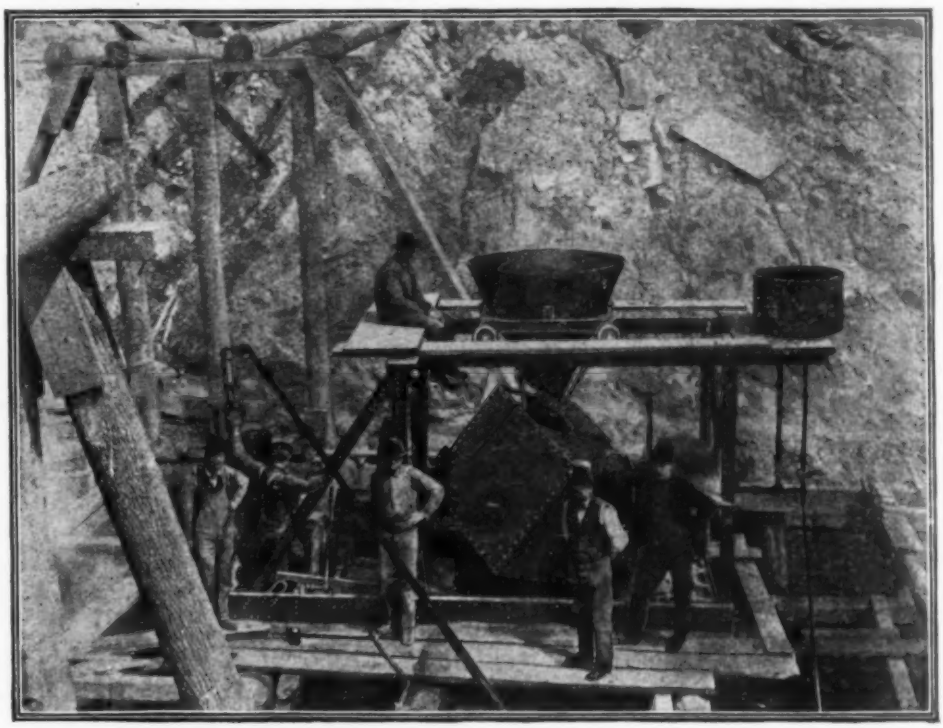


Fig. 1—Portable Cube Concrete Mixer.

handy and well adapted for big work. By a special arrangement of valves in the watering tank the quantity of water is positively measured for each bath and positively discharged for each bath, no matter how little or how much water, to the full capacity of the tank, is required.

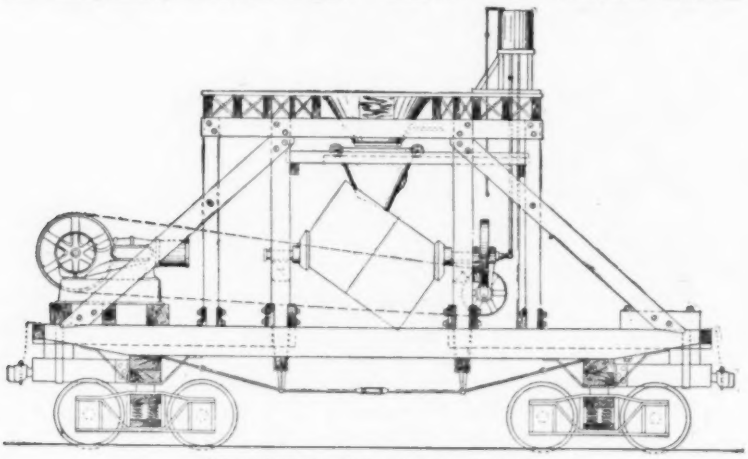


Fig. 2—Portable Railroad Concrete Mixer.

Not the least interesting of these seemingly automatic contrivances is the remarkable portable mixer (Fig. 1) which made its appearance in the construction of the Walworth Run sewers in Cleveland. This complete machine with all its working parts could be picked up by the derrick and moved about wherever desired. The machine employs a single copper hopper arranged to rack back and forth on the trackway provided on the steel frame, as shown in the illustration. The hopper is fitted with a door in the bottom. A vertical engine connected with spur gearing, operating a friction clutch, is mounted on the steel frame. In the Cleveland work the material was loaded into the hopper by means of a cable-

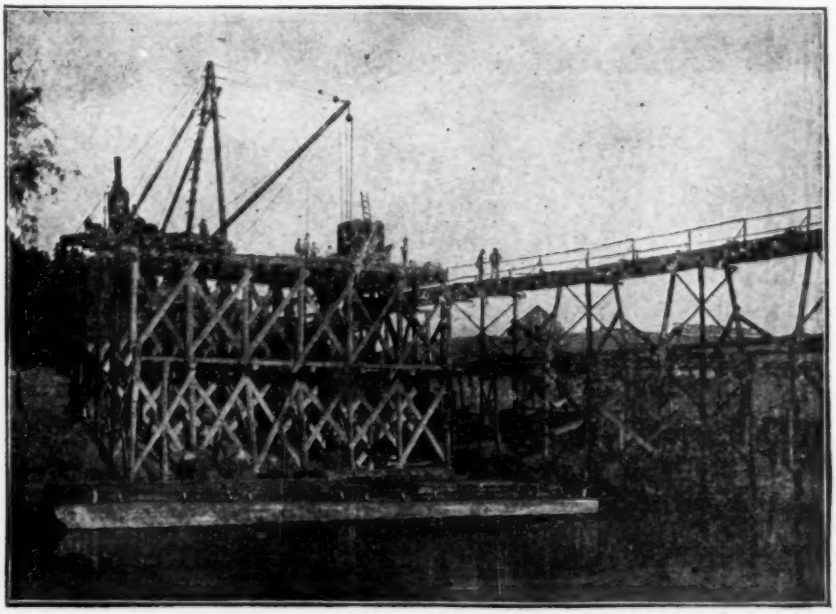


Fig. 3—Concrete Mixing Plant for Government Work on Warrior River.

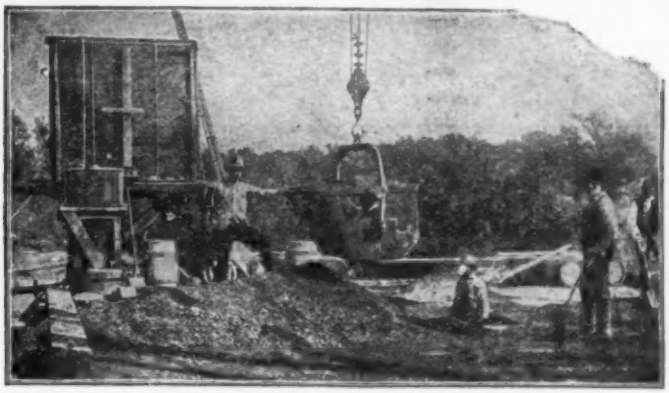


Fig. 4—Top of Mixing Platform.

way. These plants are also mounted on wheels, making a complete portable plant for street work. Some are mounted on cars for railroad work, as shown in Fig. 2.

The same general principles of mixing obtain in the standard stationary mixer as in the portable machine shown in Fig. 1. The cube is mounted through one diagonal on a hollow shaft, being secured to it by heavy cast-iron trunnions. The shaft is perforated on the inside of the cube for water emission.

Standard machines are fitted with a large worm gear mounted on a hollow shaft near one end, which is driven by a worm. The worm and gear are mounted in a self-contained dust-proof, self-oiling casing to insure alignment. The worm shaft is supported in the worm case bearing and also in two bracket bearings, and carries a fric-

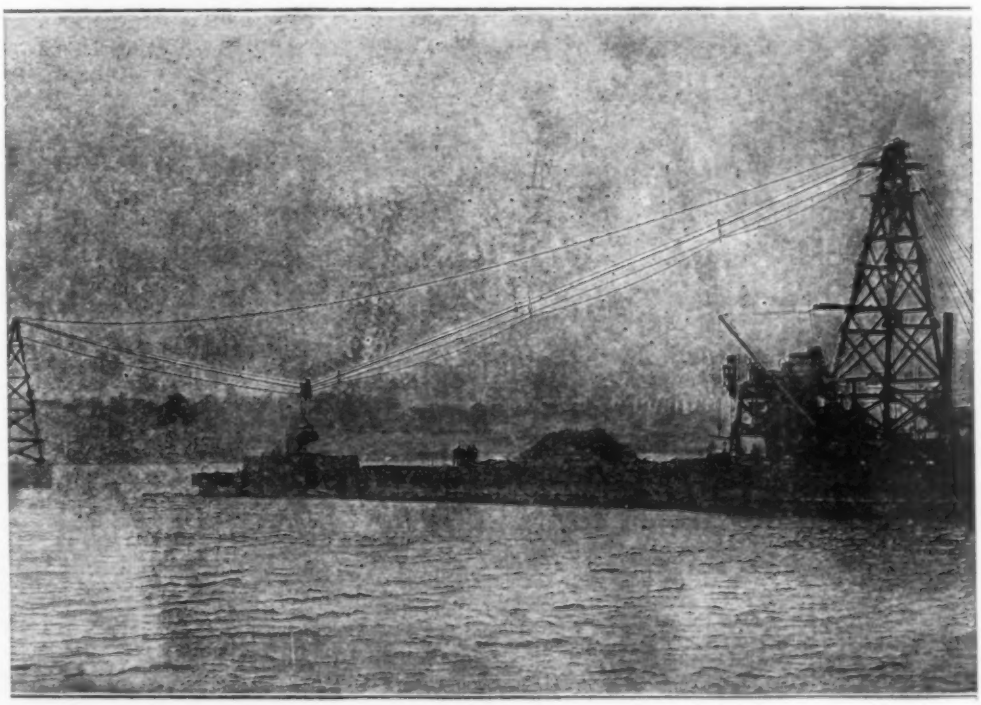


Fig. 5—Concrete Mixing and Handling at the Cleveland Breakwater.

tion clutch pulley, which permits of running the engine continuously. A five-foot mixer will turn out 375 yards in 10 hours. Fig. 3 shows a plant on the Warrior river, near Tuscaloosa, Ala., engaged in government work. Fig. 4 shows the top platform of this plant, with one of the workmen standing in the stationary hopper.

In the construction of the Cleveland breakwater a semi-portable plant was used in connection with a stone crusher, elevator and screens. The cableway shows the method of moving the old stone from the breakwater to the plant, the buckets returning filled with concrete.

NEW ECONOMICAL GAS PLANT.

For Stores, Halls and Factories

The smallest store in the smallest town can now afford to have its own gas plant and enjoy as bright a light as the best establishments in the largest cities. Not only is the plant comparatively inexpensive, but costs less to operate than any other, and insurance companies consider it safer than electricity.

Each store, hall or factory can have its own generating plant, which occupies little space and is automatic in action, requiring attention of only a few minutes once a week.

The gas machine or generator consists of a tank to hold the gasoline, a generator to change the raw gasoline into dry gas and a mixing chamber to mix the proper proportions of gas and air, a hand pump to put a few pounds of pressure on the tank to force the gasoline to the generator, and the necessary pipes and fixtures. The pipes are made of very light material and anyone can install a system in an hour's time. The fixtures are of oxidized brass and are very ornamental. They are made in two sizes, 1,000 candle power and 500 candle power. The 1,000 candle power fixtures are used for lighting large spaces, such as the main part of stores, halls, etc. The 5 candle power fixtures are for small rooms, windows, small halls, etc.

The Acorn Brass Manufacturing Company, of Chicago, which manufactures this new system, state they can light a room 30 by 30 feet in the most brilliant manner at a cost of only twenty cents a week, while a room 30 by 90 feet for less than 65 cents. The light is so strong that it is not recommended for the ordinary small dwelling house, but it makes stores, halls and factories even lighter at night than many of them are during the day. The descriptive pamphlet is extremely interesting as it gives many illustrations and tells how to install the system, which can be done by any person of ordinary intelligence, no gas-fitter being required.

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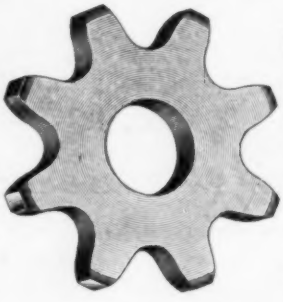

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